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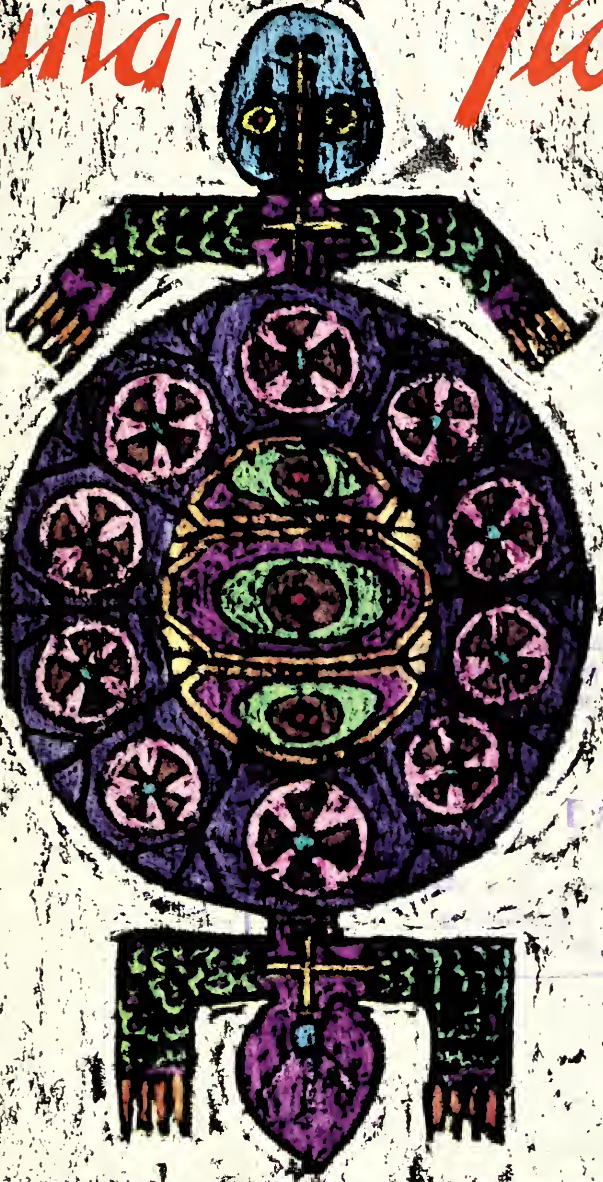

1966

No. 17 1966

ERRATUM

The name "Mr. D. C. Lourens" should be substituted for the name "Dr. Lorenz" that appeared on page 24, line 20, of Fauna and Flora Bulletin No. 16.

The late Prime Minister, Dr. H. F. Verwoerd, with a tame Eland in the Loskop Dam Nature Reserve.

FAUNA & FLORA

THE DIRECTOR OF NATURE CONSERVATION,

PRIVATE BAG 209,

PRETORIA,

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FAUNA AND FLORA BULLETIN No. 17

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FAUNA & FLORA

AN OFFICIAL PUBLICATION OF THE
TRANSVAAL PROVINCIAL ADMINISTRATION

The opinions expressed in this bulletin are not necessarily those of the Nature Conservation Branch nor of the Administration

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ADMINISTRATION OF THE PROVINCE OF TRANSVAAL
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Game Farming and Hunting Areas

T. J. Steyn

Director of Nature Conservation

"GAME FARMING" is a popular topic of discussion in South Africa at present. Not only do nature conservationists and agriculturists concern themselves with the matter, but farmers and the general public also speculate thereon. The present drought and its adverse effect on stock farming in areas like the Northern Transvaal contribute greatly to this interest. Exaggerated claims are often heard, and a call for caution will not be inopportune at this moment.

Reference is usually made (with varying degrees of accuracy) to the recent findings of scientists on the large quantities of venison that can be permanently produced by the African savannah or park-like landscape. To quote but one example, Petrides and Swank maintain that a certain national park in Uganda is capable of carrying at least five tons of live game per square mile, which weight is four times as high as that of domestic stock on the best natural range in the western United States. Further, it is often pointed out that game grows and breeds faster, is less subject to diseases and requires less labour and range management. *However, the basic principle is that game utilizes the savannah more efficiently by using everything, from the grass on the ground to the leaves on the tops of the trees.*

I do not in any way wish to contest the results of these and other scientists, but I do ask that they be further analysed before we try to apply them in South Africa. Firstly, we should note that the "great producers" like Elephants, Hippopotami and Buffaloes contribute by far the most important part to the phenomenal production of these wild areas. Conditions in South Africa simply do not make it possible to farm with such giants amidst oranges and cauliflower any longer. With the present farming pattern in the Transvaal, the animals mentioned can be conserved in the Kruger Park only.

Secondly, we should remember that the subsistence economy of the primitive African areas is no longer found in this country. Here a pound of beef or sheep's wool is worth more than a pound of venison or impala hair.

Thirdly, our whole marketing system also favours the domestic animals, and fourthly, the danger of transmissible diseases should not be underestimated.

However, the principle holds good that *mixed* veld (such as bushveld) can be utilized most efficiently by *mixed* game (such as all kinds of bushveld game), at least as far as production in weight is concerned. The concept of "mixed" is emphasized, since no evidence exists that, for example, Blesbok alone can utilize the pure grass of the High Veld better than Merino sheep, or that the Afrikaner cattle of the Low Veld can simply be replaced by a super Eland.

Is there any future for game farming in South Africa or more particularly in the Transvaal? This question is often posed to the Section. In the first place we are convinced, of course, that there is or should be room for "game" on every farm, even if in extreme cases this should only be a few steenbok, hares or even guinea-fowls on odd bits of land. In other cases, for instance on many High Veld farms, farmers find it possible to set aside a particular camp for a small herd of Blesbok which they keep for their own pleasure and use. In a few cases partial or exclusive farming with Blesbok takes place as the owners keep this antelope specifically with the view of marketing. As soon as there is marketing with a profit motive, we may speak of "game farming". As already pointed out, it is doubtful, however, whether even on the sourest High Veld grassfields Blesbok will be more profitable than sheep.

In the Transvaal bushveld there are large areas of "mixed" veld which for several reasons must be regarded as subeconomical for stock farming: sour, stony, infested with poisonous plants, subject to droughts, etc. The lands around Loskop Dam and in large parts of the Waterberg Mountains are examples of these. *We are convinced that mixed game farming can be the most economic form of land use in those parts.* However, unless very large areas are set aside for the purpose, it will not be possible to include the "great producers" like Elephant, Hippopotamus, Rhinoceros and Buffalo in the farming, but species like Giraffe, Eland, Kudu, Wildebeest, Zebra and Waterbuck can be used together with the ordinary small game.

A big problem in connection with the proposed farming is that scattered individual farmers who wish to undertake it will be forced to erect expensive game fences. However, in order to reduce costs, big blocks can be fenced collectively, as has already been done in the case of the Timbavati and Sabie-Sand Nature Reserves in the Eastern Transvaal.

Marketing will present problems initially, but the culling programmes of the Kruger Park and other reserves already necessitate research in that direction, and one or more solutions may be expected within the near future.

In the meantime hunting for sport can be used to help in solving the marketing problem. Hunting conditions outside our borders are steadily getting more unfavourable, and the demand within the Republic is increasing. It won't be long before a hunting opportunity in the Transvaal will become a luxury. Luxury articles always fetch luxury prices, of course.

The following prices were paid for carcases on the Pretoria public market during the hunting season of 1966:

Guineafowl	R1.00 — R1.20
Duiker	R4.00 — R4.20
Springbok	R6.00 — R10.00
Blesbok	R8.00 — R14.00
Impala	R7.00 — R16.00
Blue Wildebeest	R17.00 — R20.00
Kudu	R30.00 — R55.00

If a carcase is worth so much to the consumer, then the hunter should be prepared to pay the same amount plus the value of his sport to the game farmer. If the hunter happens to be an overseas tourist, he will be prepared to pay accordingly.

Where the present claims of "game farming" are mainly based on "primitive" African conditions, the case of hunting areas is just the opposite. The higher a country is developed and industrialized, the bigger is the demand for hunting opportunities, and the more the consumer is prepared and capable to pay for the product. *We are of the opinion, therefore, that hunting areas have an even better future than game farming in the province.*

The small Rodents of the Transvaal: some Taxonomic, Biogeographic, Economic and Health Problems

D. H. S. Davis

Medical Ecology Centre, Department of Health, Johannesburg

THE different species of rats, mice and gerbils belonging to the family Muridae* occurring in the Transvaal have been studied from many angles. It took nearly a hundred years to discover and name them. Then followed a period when their geographical distribution became better known as a result of surveys and other investigations conducted in connection with wild rodent plague and its control. Periodic mass increases of some of the commoner species have led to damage to agricultural crops and young forest plantations. Their possible role as definitive hosts of bilharziasis has been studied in the Low Veld; natural infections were found but various considerations rule them out as playing any part in the natural cycle of the disease.

A further aspect has been the study of fossil remains found in the Sterkfontein and Makapan areas associated with the Lower Pleistocene Ape-man deposits. Comparison of such finds with Stone Age and modern species is beginning to illuminate their evolutionary history. In all this work the problem of correct identification and nomenclature has been in the forefront, and it must be confessed that even now there are still doubts about the taxonomic status of some of them.

EXPLORATION OF THE FAUNA

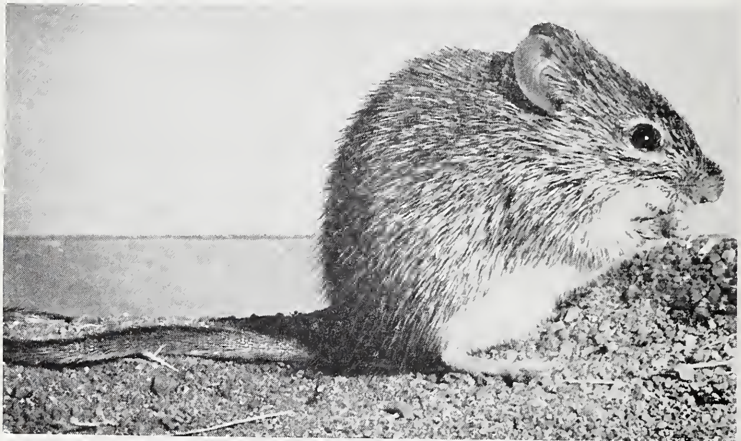

Fig. 1. The Single-striped Mouse (*Lemniscomys griselda* Thomas) first described by Sir Andrew Smith in 1845 as *Mus dorsalis* on specimens from the Rustenburg area and renamed *Lemniscomys griselda spinalis* by Thomas in 1916. *L. griselda* is restricted to the bushveld in the Transvaal.

Photo: Adolf Veenstra.

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*The classification in Ellerman, Morrison-Scott and Hayman (1953) is followed for convenience, though nowadays a different taxonomic arrangement is emerging.

The early explorers Sir Andrew Smith and August Wahlberg made the first collections that found a permanent home in museums. Smith described a number of small mammal species himself and Sundevall those collected by Wahlberg. The first small rodent to be described from the Transvaal was named by Smith (1836) as "*Mus marikquensis*" which he collected in "the country beyond Kurrichaine" (= Groot Marico). This is the western Transvaal form of the Multimammate Mouse (*Praomys* (*Mastomys*) *natalensis marikquensis*) which Smith noted as "also found in the kraals of the Natives". Later, in 1845, Smith described *Mus dorsalis* the Single-striped Mouse, now known as *Lemniscomys griselda* (Fig. 1) since the specific name *dorsalis* was later discovered to have been used for another kind of *Mus*. Sundevall (1846) described the first Black-tailed Tree-rat (*Thallomys*) as "*Mus paedulcus*" on specimens collected by Wahlberg at his camp on the Crocodile River north of the Magaliesberg; he stayed there for two months from November 1841 before continuing his journey via Mamagalies Kraal by following the wagon trail leading to a saltpan (evidently the Pretoria Saltpan); thence he pushed on through trackless country to the lower reaches of the Aapies river. He started his return journey to Durban in March arriving in August 1842 "with his wagon richly loaded with collected specimens" (Groenberg, 1951 and see also Gyldenstolpe, 1934).

About fifty years passed before any more serious collecting was done. A few years after the turn of the century the Rudd expedition, led by C. H. B. Grant, made a series of collections in southern Africa which enabled Oldfield Thomas and others at the British Museum to describe many new forms, those from the Transvaal being reported on by Thomas and Schwann (1906a, 1906b).

In 1910 Austin Roberts joined the staff of the Transvaal Museum to take charge of the bird and mammal collections. His great work on the birds was published in 1938 and he had completed the manuscript of the book on the mammals at the time of his tragic death in 1948. The book appeared in 1951 and contained the fruits of much detailed study, particularly of the small mammals, many of which he collected personally on his numerous expeditions. In the early twenties, when it was discovered that bubonic plague had become implanted in wild rodents over large tracts of South Africa, including the southern Transvaal (Mitchell, Pirie and Ingram, 1927), Dr. Roberts was called in. He was the first mammalogist to study South African rodents from this angle, and much of his collecting and taxonomic work was dictated by the plague danger and the need for accurate identification of the rodents concerned (Roberts, 1935). Many specimens collected in all parts of southern Africa by field-workers on plague were sent to him and new forms were described from these and his own collections. His taxonomic work was continued by his successor, Dr. Bengt Lundholm, who made signal contributions (Lundholm, 1955a, 1955b) to resolving many taxonomic puzzles and to reconciling the divergent nomenclature attached to "species" by Roberts and by Ellerman, Morrison-Scott and Hayman (1953) in their re-classification of Southern African Mammals. Happily this reconciliation is all but achieved with the Muridae (and most other groups). Meester (1964) incorporated these revisions in an up-to-date provisional checklist and key to southern African Mammals issued in mimeograph form and due to be published, with further revisions, in the near future.

It is thus only comparatively recently that a fair degree of stability has been reached in assigning taxonomically "correct" scientific names to southern African murids (Davis, 1962, 1965), but there still remains the problem of deciding whether the variation met with its clinal (i.e. geographical) or has reached subspecific level. As specimens accumulate — and many more are wanted — it becomes easier to decide whether variation can most realistically be expressed as clines or whether certain groups of populations are morphologically distinct and geographically isolated enough to warrant subspecific names.

There are approximately 30 species of Muridae to be found in the Transvaal, and the distribution patterns of the commoner species are reasonably well known (Davis, 1962). The Transvaal falls into the Southern Savanna Biotic Zone, but within it there are isolated patches of montane grass-land and evergreen forest which have a particular interest, chiefly on account of their greater extent in former times of higher rainfall and virtual non-existence in times of lower rainfall (see maps in Cooke, 1964). The unravelling of the murid faunal relationships can only be attempted when more detailed surveys have been undertaken to provide comparative material from these now isolated blocks of forest and montane grass-land. With further intensive collecting, especially of the thicket rats of the genus *Thamnomys* and the vlei rats of the genus *Otomys,* much of interest is likely to emerge. An excellent starting point would be the Blyderivierspoort Nature Reserve.

Another interesting faunal area lies in the semi-desert belt between the Soutpansberg and the Limpopo, which in the past must have been an outlier of the Kalahari; there is an isolated relict population of the Pygmy Gerbil (*Gerbillus paeba*) persisting there, whose main distribution area is in the South West Arid zone (see map in Davis, 1962). This again is a region that would repay more intensive study, and the Langjan Nature Reserve would make a convenient base of operations.

The murid fauna of the Low Veld and bushveld is fairly uniform, but there is a strikingly sharp transition roughly along Lat. 26deg.S, between the bushveld savanna and grass-lands of the southern Transvaal High Veld (see Acocks, 1953). The African Bush Rat (*Aethomys chrysophilus*) and the Single Striped Mouse (*Lemniscomys griselda*), for example, both stop abruptly along this line. On the other hand such species as the White-tailed Rat (*Mystromys albicaudatus*) and the Large-eared Mouse (*Malacothrix typica*) do not extend from the High Veld grass-lands into the bushveld (see maps in Davis, 1962). An almost exact parallel is found amongst antelope species: for example impala and kudu are restricted to the bushveld side of the line and springbok and blesbok (before they were introduced on to bushveld farms) to the High Veld side (Kettlitz, 1962).

The species assemblages attached to forest, savanna and semi-desert would probably have accompanied any expansion or contraction of such zones in response to past climatic changes which are known to have occurred (Clark, 1959; Cooke, 1964). These changes have not been of very great magnitude (Bond, 1964), but sufficient to have left their mark.

The rich deposits of fossil microfauna recovered in the course of the search for Ape-man fossils from the Sterkfontein area and from Makapansgat have been investigated up to a point (de Graaff, 1961), but much critical work needs doing to establish the precise relationship of fossil murids to present day species. Some forms appear to be identical with those alive today, others differ slightly and others again have no modern counterparts (Davis, 1962). Together with collections from later deposits, such as those from the Cave of Hearths at Makapan (de Graaff, 1961), it will eventually be possible to trace the history of the murid fauna over the past million or so years of the Pleistocene: one thing is certain, and that is that during the Pleistocene there has been a shift in species-dominance. The Ape-man deposits are numerically particularly rich in cricetines (*Mystromys* spp.) and relatively poor in murines, though most of the modern genera are represented (de Graaff, 1961; Davis, 1962).

AGRICULTURAL AND FORESTRY PROBLEMS

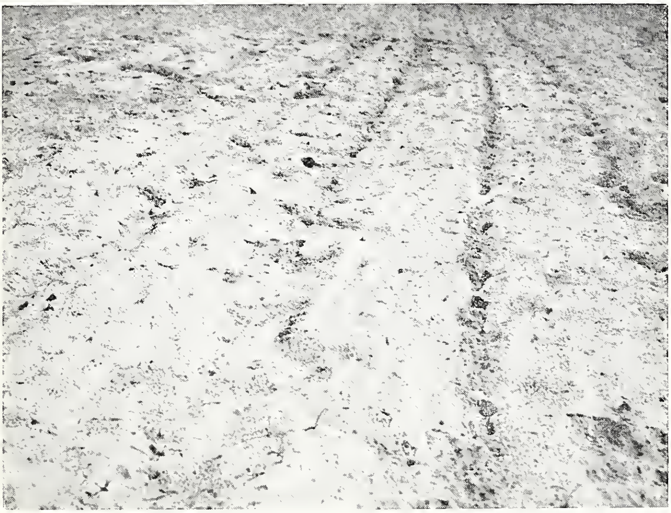

Fig. 2. Damage by gerbils *Tatera brantsii* to newly planted maize in the Eastern Transvaal. The first sowing was destroyed: this photograph shows what happened to the second sowing — every germinating seed has been dug out.

Photo: A. D. Thomas.

The High Veld Gerbil (*Tatera brantsii*) undergoes periodic increases in numbers every 8 to 10 years in the grain lands of the eastern Transvaal. Population densities as high as 200 animals per morgen are reached in certain areas and newly planted maize, soon after germination, is often completely destroyed. When the lands are ploughed and planted to maize, gerbils systematically work along the rows digging out the newly germinated seeds (Fig. 2). Stands of wheat and oats are similarly destroyed, large patches being eaten to the ground (Fig. 3). An aggravating factor, apart from the loosening of the sandy soil through ploughing, has been the invasion of fallow lands by the Water-grass or Uintjie (*Cyperus esculentus*) and other weeds which provide a virtually inexhaustible food supply, much richer than the natural grass-veld which is not known to support such high concentrations (Davis and Thomas, 1942).

The Multimammate Mouse (*Praomys natalensis*) is also subject to periodic increases with consequent depredations on growing crops, and also to harvested grain in storage, since this species, being semi-domestic in habit, lives in huts and outbuildings as well as in the lands, a fact, already mentioned, that was first noted by Andrew Smith during his expedition to the Transvaal in the eighteen thirties (Smith, 1836).

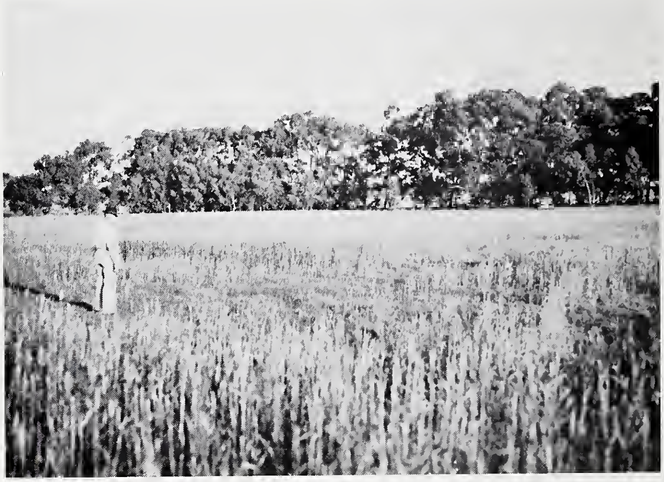

Fig. 3. Damage by gerbils *Tatera brantsii* to an oat land in the Eastern Transvaal. The bare patch is honeycombed with burrows and the oats destroyed.

Photo: A. D. Thomas.

No research has yet been done to account for the sudden die-off or crash in numbers that terminates such outbreaks in this country, although in Europe and America a hormonal imbalance developing as a result of stress and affecting reproductive capacity has been given as an explanation.

The Striped Mouse (*Rhabdomys pumilio*) and the vlei rats of the genus *Otomys* (*O. irroratus angoniensis* and *laminatus*) have been responsible for large-scale ring-barking of young pines and other trees in forestry plantations (Fig. 4) (Davis, 1942). Damage occurs during the autumn and winter months when the ground vegetation has died back. Ring-barking is confined to young plantations before the grass cover has been suppressed by the canopy, which forms when the trees are about five years old. Heavy losses have been experienced in the Sabie area for example, one concern estimating its annual loss at R120,000 until control with warfarin poison baits was put into routine operation to keep numbers in check (Schulz, 1953, 1962).

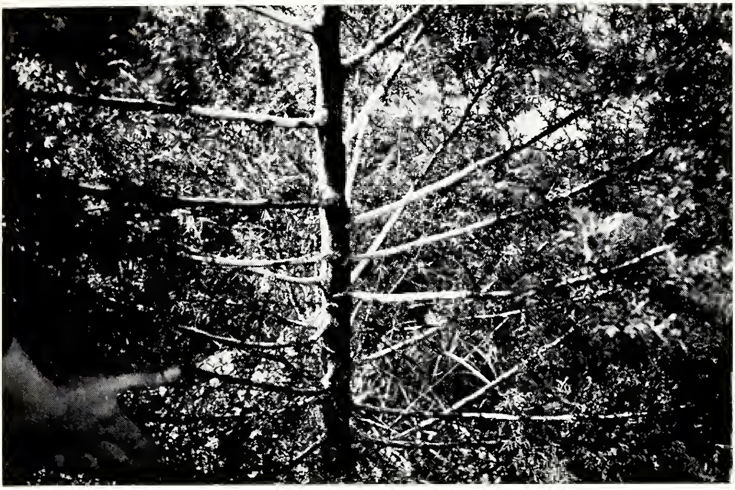

Fig. 4. A ring-barked cypress. The bark has been stripped from the stem and laterals of this young tree; vlei-rats (*Otomys*) and striped mice (*Rhabdomys*) are the chief culprits.

Photo: D. H. S. Davis.

Bubonic plague has been prevalent from time to time in the southern, western and north-western Transvaal (Davis, 1948 & see map in Davis, 1964), but there have been no recorded outbreaks since 1951 either in man or rodents. However, there are grounds for believing that plague still persists in some areas and currently a serological survey is being conducted to determine whether plague antibodies can be detected in the blood serum of small mammals (Hallett, 1965). So far the south-west Reef area has been surveyed with almost negative results, and it would seem that the concerted efforts by the Reef Field Plague Committee established in 1951 (Rose Innes, 1952) to co-ordinate control work between the different local authorities have been successful. From experience elsewhere we know that plague may persist for many years without showing signs of its presence, and it is still conceivable that it may reappear.

Bilharziasis, as everyone knows, is particularly prevalent in the Low Veld and some species of Muridae have come into the picture. Schistosomes have been found naturally infecting wild rodents in various parts of Africa (Nelson, Teesdale and Highton, 1962). With the knowledge that the Multimammate Mouse was highly susceptible to *Schistosoma mansoni* in the laboratory (Lurie and de Meillon, 1956) and that it often comes into contact with water, the CSIR Bilharzia Research Unit (Pitchford and Visser, 1962a) examined 3,705 wild rodents (of which 1,890 were multimammates) in the Nelspruit area for signs of infection and found that 46 Multimammate Mice, 5 Vlei Rats (*Otomys angoniensis*) and one Single-striped Mouse (*Lemniscomys griselda*) were harbouring schistosomes. However, on reviewing the evidence it was concluded that wild rodents were unlikely to play any part in maintaining the cycle of infection, both because of the low incidence of infections amongst them and of their short lifespan, which more or less ruled out the 'carry-over' of infection from one season to another. White mice and then multimammate mice were subsequently used extensively to measure the infectivity of different water bodies by exposing them at the water's edge in cages to any free-swimming cercariae present (Pitchford and Visser, 1962b). Being a larger and hardier animal than the white mouse, the multimammate proved best for this purpose and many thousands have been used, giving valuable indications of the variation in infectivity of different parts of a river or dam at different times of the year.

FUTURE WORK

There is still much basic work to be done on the taxonomy and geographical distribution of Transvaal Muridae, and the field stations and nature reserves of the Nature Conservation Department provide excellent facilities for systematic collecting. It would be particularly interesting to make a comparative study of the murid fauna at high altitudes at a series of points along the length of the escarpment, including the Soutpansberg, to discover whether subspecific differences can be detected in the species inhabiting geographically isolated blocks of montane grass-land and evergreen forest. Then again, the semi-desert belt between the Soutpansberg and the Limpopo River, with its former Kalahari connections, offers an interesting field for intensive collecting to determine whether 'desert' species other than the Pygmy Gerbil (*Gerbillus paeba*) occur there.

Comparatively little is known of the fossil and subfossil microfauna of the Stone Age and Iron Age sites which abound in the Transvaal. With the current interest amongst archaeologists in obtaining every scrap of information from such sites as a means of interpreting the ecological conditions prevailing in former times, the moment is opportune for attempting to fit any murid remains found into the evolutionary picture from Ape-man times onwards.

A systematic study of the factors influencing the rise and fall of rodent numbers in southern Africa has yet to be made. The key problem is to discover factors apart from infectious disease to account for the decline that inevitably follows a period of abundance. The High Veld Gerbil and the Multimammate Mouse have, it is true, been extensively studied in the Transvaal, and their breeding rhythms established (Measroch, 1954; Allanson, 1958 for the gerbil and Coetzee, 1965 for the multimammate), but much remains to be done, especially from the physiological angle, in relation to breeding success. This is a wide research field, but one of practical importance to agriculture, forestry and health.

The extension of the plague serological survey to areas other than the south-west Reef is needed to determine whether the former known foci still persist in the western and north-western Transvaal.

With the great expansion of irrigation schemes and the necessity for surveillance of the bilharzia threat, the routine use of multimammate mice as test animals for determining the infectivity of various water bodies should prove a useful adjunct to standard survey methods.

This brief survey of some of the work that has been done on Transvaal Muridae is intended to high-light the major problems and to indicate profitable lines for future research, both basic and applied.

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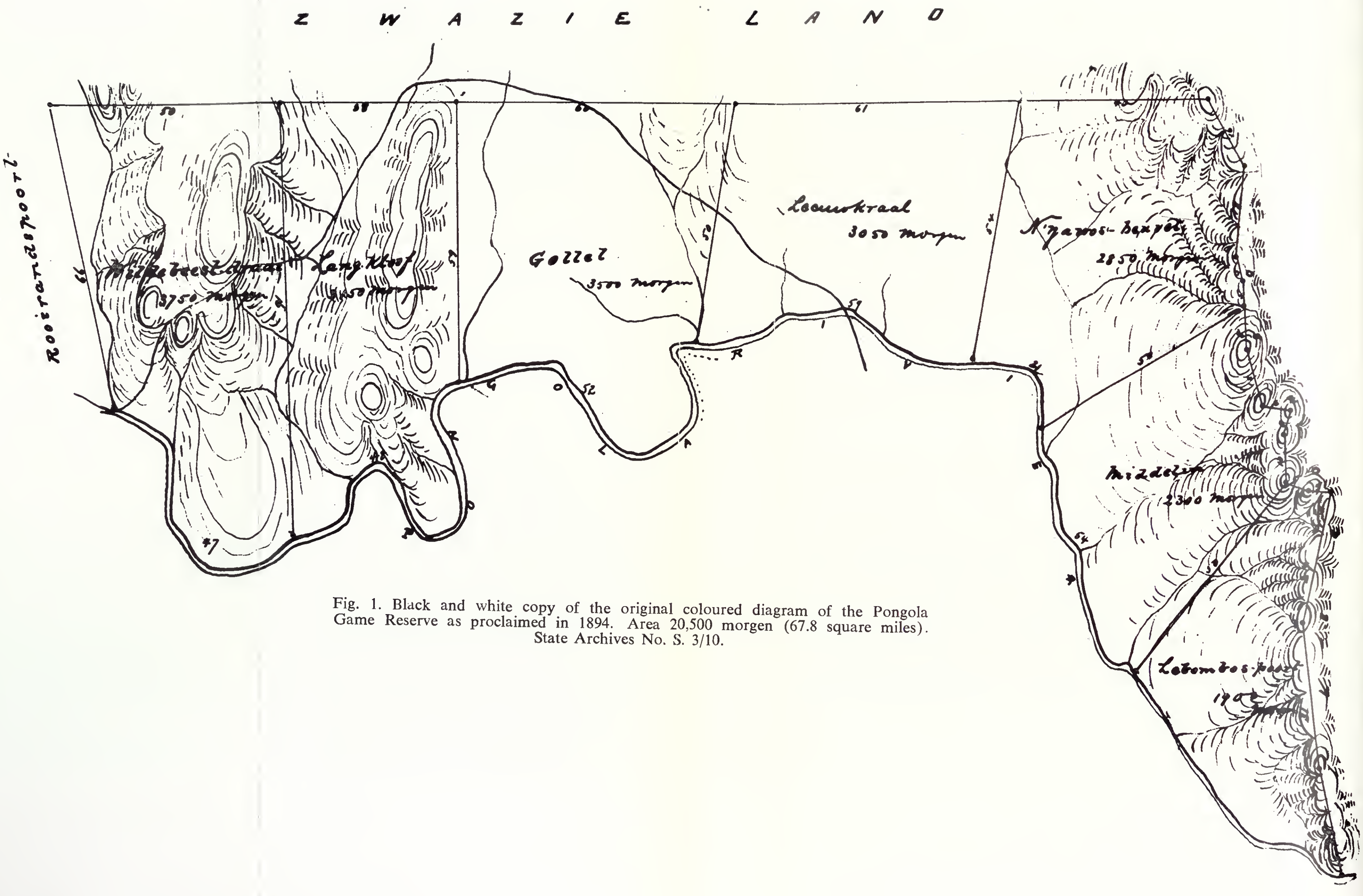

Fig. 1. Black and white copy of the original coloured diagram of the Pongola Game Reserve as proclaimed in 1894. Area 20,500 morgen (67.8 square miles). State Archives No. S. 3/10.

South Africa's first Game Reserve

R. Bigalke

IT is now generally realized that the Republic of South Africa is playing a very important part in the conservation of wild life. But very few people seem to be cognizant of the fact that the first game reserve in South Africa was proclaimed by the President of the South African Republic (now the Transvaal Province) as far back as 1894, or only twenty-two years after the world got its first national park, the Yellowstone National Park in the United States of America.

South Africa's first game reserve, and probably the first in the whole of Africa, was the Pongola Game Reserve. It lay in the narrow strip of territory in the Eastern Transvaal bounded by Swaziland on the north, the Lebombo Mountains on the east and the Pongola River on the south (Fig. 1).

For nature conservation in South Africa the 2 August, 1889, is a very important date, for it was on that day that the late S. J. P. Kruger, President of the S.A. Republic, spoke in the Volksraad in support of an Executive Council's resolution requesting that steps be taken to prohibit hunting on some of the Government's land. He pointed out that such action was necessary in view of the rapid rate at which the Republic's game animals were being destroyed (9). The President stated that where the Pongola River flows through the Lebombo Mountains there were still buffaloes, elephants and giraffes, and that it was this locality in which the Government was especially interested. He felt that in areas where there was little hunting it was especially important to preserve the game for future generations. The proposal was adopted with only two dissentients. Five years later, more precisely on the 27 August, 1894, the Volksraad agreed to the appointment of a warden for the Pongola Game Reserve at a salary of ten pounds per month (11). Somewhat later Mr. H. F. van Oordt was appointed to this post — the first game warden of the Transvaal.

Since the establishment of the Pongola Game Reserve is of great historical interest and importance, it is desirable to quote the proclamation that appeared in the "Staatscourant der Zuid-Afrikaansche Republiek" on the 13 June, 1894 (10). It reads as follows when translated:

PROCLAMATION R8009/89

"I, Stephanus, Johannes, Paulus Kruger, State President of the South African Republic, acting on the advice and with the consent of the Executive Council and authorized thereto by the Honourable Volksraad by resolution of the 2 August, 1889, article 1244, herewith make known and proclaim the following farms in the bushveld of the district Piet Retief between the Pongola, Swaziland and Lebombo as a GOVERNMENT GAME RESERVE viz.: Lebombopoort, Middelin, Njawósheuvel, Leeuwkraal, Gollel, Langkloof and Wildebeestdraai".

"The boundaries of this Game Reserve are as follows: from beacon No. 1, a reddish rock, where the Rooderand reaches the Pongola River and where the waggon road is a narrow passage between the river and the rock; thence along the watershed of the Rooderand (Bandabande and Bompuhlela) up to the boundary of the S.A. Republic and Swazieland; thence along the aforesaid boundary line up to the point where the Lebombo Mountains and the Pongola River meet (Pongolapoort); thence along the Pongola River up to beacon No. 1" .

"Within this boundary one and all are prohibited from hunting, shooting, searching for, or in any manner taking possession of or trying to take possession of. chasing, driving away or disturbing game in any manner whatever".

"Persons contravening these provisions will be punished by seizure of all game and shooting and hunting appliances in their possession and a fine not exceeding one hundred pounds sterling (£100). In default of payment imprisonment will be imposed for a period not exceeding one year".

NOTE: In modern usage the word "wildtuin" used in the original proclamation is generally taken to be the equivalent of "national park". But as the modern concept of a national park was hardly known in South Africa in 1894, and the early reserves were proclaimed as game reserves, it is this term that has been used above for "wildtuin".

In the year 1903 (12) the Pongola Game Reserve was reproclaimed by the Colonial Government and remained in existence until the 12 January, 1921, when it was deproclaimed by Administrator's Proclamation No. 1, 1921 (13). But the latter provided for the protection of all game animals and game birds on the farms that constituted the reserve prior to deproclamation. How effective this protection was is not known.

It is a great pity that the Transvaal's first game reserve was abolished in the year 1921, and it is natural to enquire why such action was taken. No reason is given in the Administrator's Proclamation, nor have I been able to find any resolution concerned with this matter either in the Transvaal Executive Committee's Minutes or in the Votes and Proceedings of the Provincial Council. Curson and Hugo (1924) are no doubt correct in stating that the decision was taken in consequence of a nagana epizootic in Zululand in the year 1920. Since tsetse flies were present on the eastern side of the Lebombo Range along the Pongola River. it was feared that they might extend their range westwards along that river to the reserve, especially if the game animals moved to and fro (op. cit.). It was due to the fear that the disease might spread into Swaziland that Proclamation No. 39 of 1922 was issued by the Swaziland Administration (op. cit.). In this proclamation it is specifically stated "whereas it is desirable for the prevention of the spread of disease to enable game to be hunted throughout the year within a certain area in Swaziland . . . , I do hereby declare, proclaim etc." The disease concerned was nagana, of which tsetse flies are the vectors; it was not known to exist on the western side of the Lebombo Mountains. About 160 square miles of a Swaziland game reserve were opened for hunting, as it was thought that this would prevent the spread of nagana by game from Zululand to Swaziland (op.

cit.). In this connection it is interesting to note what the warden of the Pongola Game Reserve, H. F. van Oordt, wrote in his second report (v. Oordt, 1896). He states that he had heard of complaints that tsetse flies had found their way into the reserve and goes on to say "if this were indeed the case, no one would suffer except myself and the police, since no one is entitled to be in this remote corner, but I am able to state that the rumour is devoid of all substance, since there are no flies at all in our reserve (i.e. the Pongola Game Reserve — author); during my residence of more than seven years in this area, I have never come across any (tsetse) flies. It seems as if they disappeared with the elephants".

In his first report the warden states (v. Oordt, 1895) that although game was very scarce in this reserve at first, it gradually began to increase and became tamer. As he took immediate steps to destroy all dogs, this resulted in most young animals reaching maturity. In this report he enumerates the following kinds of game animals as being present: Kudu, Waterbuck, Hartebeest, Tsessebe, Blue Wildebeest, Zebra, Impala, Reedbuck, Bushbuck, Mountain Reedbuck, Grey Duiker, Steenbuck, Klipspringer, Red Duiker, Inyala (very scarce), Warthog and Bushpig. Although the President referred to the presence of the Giraffe when he addressed the Volksraad in 1889 (see above), this must have been an error, since this animal is not mentioned in any of van Oordt's reports.

Now and then a few rhinos, Black as well as White, could be seen; he expected them to remain permanently once they realized that they were not being persecuted. African Elephants that used to visit the reserve were destroyed in Swaziland a few years previously. Hippos and lions are also mentioned, but during the year under review only tracks of five lions were seen; they had trekked through in wet weather from the Vryheid district to Swaziland. Leopards were plentiful but seldom seen; he set spring-guns for them. Hyaenas and wild dogs and even jackals were scarce, and thus francolins were plentiful and so tame that they frequented the vicinity of his house and came to look for food where his horses were kept. Duikers also fed at a distance of two to three hundred yards from his house, and guinea-fowls were also tame. Among the latter there was a very rare and pretty kind with a crest of black feathers on the head instead of the red casque of the other kind; its feathers are of a bluish-green colour, and it occurred for the most part on and near the Lebombo Mountains (this is the Crested Guinea-fowl *Guttera edouardi* — author).

It is of special interest that van Oordt records the occurrence of both the Hartebeest and the Tsessebe in the Pongola Game Reserve. As he also distinguished between the Black and the White Rhino (see above), it is clear that he was familiar with the country's big game. The hartebeest could only have been one of two species, namely either the Red Hartebeest (*Alcelaphus buselaphus*) or Lichtenstein's Hartebeest (*A. lichtensteini*), but unfortunately it is not possible to state with certainty which of the two kinds. Shortridge (1934) writes that Lichtenstein's Hartebeest is believed to have extended formerly as far south as Swaziland, and that the extinct Zululand Hartebeest, usually credited to have been the Cape (Red) Hartebeest, might possibly have been Lichtenstein's Hartebeest. Apart from these vague statements, Dr. C. Bigalke of the Natal Parks, Game and Fish Preservation Board, has furnished me with a number of references on the occurrence of hartebeeste in Zululand, but only in one, that of Delegorgue (1847), is it mentioned that the animal was *Acronotus caama,* which is a synonym of the present name *Alcelaphus buselaphus* for the Red Hartebeest. If Delegorgue's identification is correct, then it is the Red Hartebeest that formerly occurred in Zululand, and most probably also this species seen by van Oordt in the Pongola Game Reserve.

Van Oordt (1895) states that since the game increased rapidly under strict protection during the first year, he cherished the hope that it would be very plentiful within a few years, and that other kinds would find their way into the reserve, especially from Zululand, where game was abundant. He mentions six zebras and several hartebeeste that found their way into the reserve from Swaziland shortly before he wrote the report.

An important antelope not mentioned in any of van Oordt's three reports is the Sable Antelope (*Hippotragus niger*). Elsewhere (Bigalke, 1955) I have dealt with this antelope's former distribution in the southern Low Veld of South Africa and indicated that the Komati River in Swaziland was roughly the southern limit of its distribution. Both this antelope and its cousin the Roan Antelope (*H. equinus*) did not occur in the Pongola Game Reserve, as they are not mentioned by van Oordt.

The greater part of the seven farms that constituted the original Pongola Game Reserve will be submerged when the Pongola Poort Dam (Josini Dam) is full. But a steep section of the Lebombo Mountains on the eastern side of the dam will not be submerged and will form a very imposing background for the dam. If an adjacent area on the Natal side of these mountains were also made available, a nature reserve of some size could be established. On account of its very rugged nature the Transvaal section would be a strict nature reserve. (Fig. 2A).

The unsubmerged parts of the farm Gollel and of the present farms Leeuwkraal and Nahala will form a continuous area that could also be a nature reserve and that will have suitable spots for rest-camps. This area will be separated from the other one by an arm of the dam, but as a nature reserve it will undoubtedly be very popular among tourists and anglers. (Fig. 2B).

Transvaal's Director of Nature Conservation is anxious to have a part of the original reserve reproclaimed as a nature reserve. For historical and prestige reasons it is very important that this should be done.

There is no doubt that anglers will flock to the Josini Dam, since a preliminary survey has revealed that the following kinds of fish are present in the Pongola River: *Labeo rosae,, L. rubropunctatus, Clarias gariepinus, Hydrocynus vittatus, Tilapia mossambica* and a few smaller kinds.

Mr. M. van Biljon, Superintendent of Gardens of the Nature Conservation Branch, has explored most of the area of the Pongola Game Reserve as originally constituted and has kindly supplied the following information about the vegetation.

About eighty per cent of the total area lies between 500 and 1,000 feet above sea-level; it includes the western farms and a strip along the Pongola River. On its eastern side the Lebombo Range rises steeply from the river up to a height of about 2,000 feet. Two vegetation types can be distinguished in the area, the low-lying bushveld and the montane vegetation.

In the low-lying bushveld the temperature may go up to 108°F and here there are typical Low Veld trees like the Fever Tree (*Acacia xanthophloea*), Knob-thorn (*A. nigrescens*), Red Thorn (*A. gerrardi*), Red Ivory (*Phyllogeiton zeyheri*), Tambotie (*Spirostachys africana*), Wild Olive (*Olea africana*), Buffalo-thorn (*Ziziphus mucronata*), Sycamore Fig (*Ficus sycomorus*), Marula (*Sclerocarya caffra*), Wild Pear (*Dombeya rotundifolia*), Resin Tree (*Ozoroa paniculosa*), Red Bush-willow (*Combretum apiculatum*), Russet Bush-willow (*C. hereroense*). Naboom (*Euphorbia ingens*). Rubber Euphorbia (*E. tirucalli*) and many others. *Aloe umfoloziensis* and *A. parvibracteata* and their hybrids are widely distributed throughout the area. On a hill along the river there are specimens of *Aloe bainsii* the tallest of which is about 30 feet high.

Much, if not most, of the low-lying bushveld will be submerged when the Pongola River Dam is full.

The montane vegetation lies on the western slopes of the Lebombo Range. Here the gradient is very steep rising from about 500 feet along the river to 2,000 feet on top of the mountains. The vegetation is dense along the river but becomes more open as one proceeds upwards. There are thick bush patches on the slopes and in these one finds the cycad *Encephalartos lebomboensis*. The vegetation becomes more luxuriant in the poort, where there are also very large trees fringing the river.

Van Oordt's three reports are very valuable, not only because they are the first reports on the first game reserve in the Transvaal, but because no later reports were issued.

When the Pongola Game Reserve was reproclaimed in 1903, it was placed in charge of Stevenson-Hamilton (1937) and Major A. A. Fraser was stationed there. But when Hamilton visited the area in the same year, he came to the conclusion that it was not justifiable to keep the 'major in this small reserve with apparently little resident game, especially as a permanent white official was urgently needed in the large Shingwedzi Game Reserve of some four thousand square miles. Hence he decided to transfer Fraser thither and arranged to leave two Bantu police constables in charge of the Reserve under supervision of the magistrate at Ingwavuma. Fraser moved to Shingwedzi early the following winter (op. cit.). This arrangement, which remained in operation until the Pongola Game Reserve was deproclaimed in 1921, accounts for the fact that no reports on this reserve were submitted after it had been reproclaimed in 1903.

The help given by officials of the State Archives, the Provincial Archives and the State Library in tracing references, and also by Mr. Louis Steyn of the Nature Conservation Branch is gratefully acknowledged.

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Flowering Aquatic Plants in South Africa

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THE FIRST plants to appear on our planet grew in the sea, but when dry land was formed they invaded this new territory. At present the flowering plants, the last to arrive on the scene, dominate our vegetation even penetrating into hot dry deserts and cold high mountain-tops. Some flowering plants, however, again returned to an aquatic life and as a result acquired some interesting adaptations in order to survive.

Plants living at the side of the water must be able to contend with an airless water-logged soil. The classical example of adaptation here is the mangrove, which inhabits some of our warmer estuaries; this plant sends up breathing roots. However, smaller freshwater plants have also devised ways and means of overcoming this handicap. The common yellow-flowered *Ludwigia stolonifera* forms a circle of short, white, spongy roots which bouy up the flowering branch. The aerenchyma or spongy tissue in these roots also allows for better ventilation. Spongy roots are also present in many of the free-floating Bladderworts (*Utricularia* spp.). But *Utricularia* has become specialized even further: the ramified "roots" possess hundreds of tiny bladders supplied with trap-door entrances. Minute swimming animals get caught and perish inside the bladders, their bodies providing the plant with valuable proteins.

Plants that have completely invaded the water show a wide range of adaptations. There is the water-lily with its flat floating leaves and beautiful flowers appearing above the water. In others even the leaf may be submerged, but the flower is still exserted in order to ensure pollination by wind or insects. How complicated their life history can then become is shown by one of our very common pond-weeds *Lagarosiphon muscoides*. Here the male and female flowers grow on separate plants. In the axils of the leaves small cups appear; inside the male cups up to fifty flowers are formed but they mature successively. On a warm sunny day a flower-bud breaks off and rises to the surface, buoyed up by an air bubble within. After a while the bud suddenly unfolds, the six perianth segments curve back and the flower floats high on the water. The three feathery staminodes (sterile stamens) are fused together at the tip and act as a sail. The little pink flowers sail around at a quite remarkable speed when slight winds waft them about. At the end of summer some farm dams are partly covered by a mauvy pink scum consisting of millions of tiny male flowers. The three stamens stand out horizontally and each locule (pollen-box) forms four tetrads, that is there are four balls each made up of four pollen-grains. When floating about they are at the same level as the feathery dark-red stigmas and so can deposit their pollen-grains between the rough papillae formed on the stigmas.

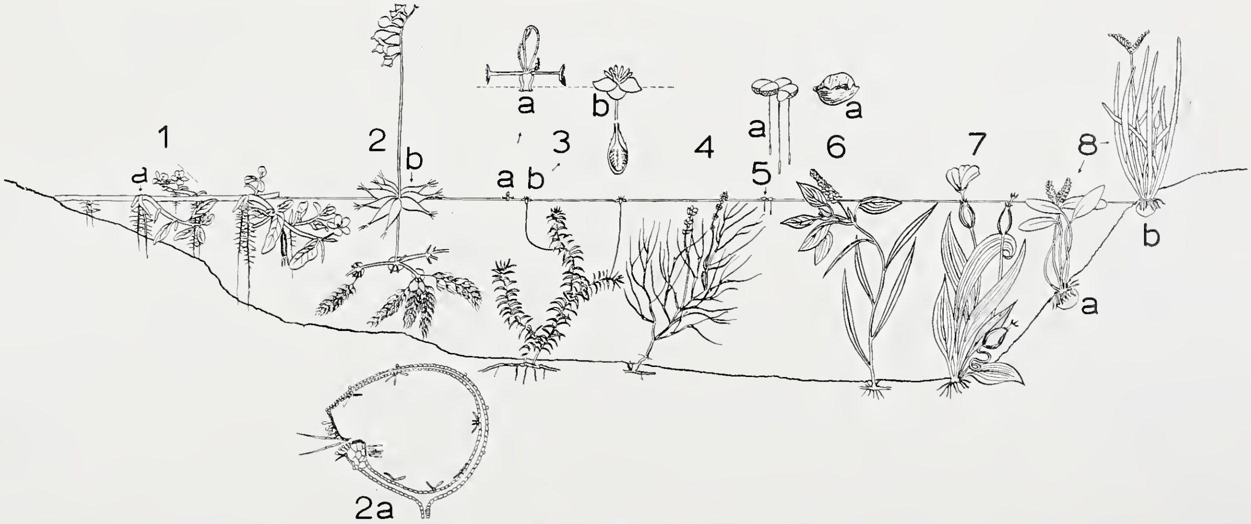

Diagram of flowering aquatic plants in a dam.

1. *Ludwigia stolonifera.* a. Floating bladders.
2. *Utricularia inflexa.* a. Bladder, much enlarged.
   b. Floating bladders.
3. *Lagarosiphon muscoides.* a. Male flower.
   b. Female flower.
4. *Potamogeton pectinatus.*
5. *Lemna gibba.* a. Enlarged plant.
6. *Potamogeton thunbergii.* a. Nut. enlarged.
7. *Ottelia ulvifolia.*
8. a, b. *Aponogeton junceus.*

The female flower is also formed in a small cup found in the axil of a leaf. There is, however, only one flower inside each cup, and moreover it remains attached to the plant; exserted from the cup a long, sometimes very long, tube is formed which must reach the surface. When growing the tube is buoyed up by a stream of air bubbles that are formed within. When it reaches the surface, the perianth segments expand and form an unwettable saucer; above it stand the six feathery stigmatic arms. When pollination has been effected, the pollen-tube must grow down the long flower-tube to reach the ovules below — sometimes as much as 25 cm. This type of pollination is referred to as the "boat-mechanism".

Along the coast, in fairly calm estuaries and brackish lakes, *Ruppia spiralis* is a very common "water-grass". This species produces unwettable pollen which floats about and may reach a female flower just exserted above the surface of the water.

In a further adaptation to an aquatic life, even the flowers remain submerged. Several species commonly found in southern Africa belong to this category, e.g. the Saw-grasses (*Najas* spp.) and several "water-grasses" such as the widespread *Zannichellia palustris* and the endemic *Z. aschersoniana.* As attractive flowers which can lure insects are no longer necessary, the flower parts are reduced to a minimum; there is only a stamen and an ovary. The pollen is fairly buoyant and the currents help to carry it to receptive stigmas.

Flowering aquatics are well known from our rivers, dams and marshes, but few people are aware that some species also grow in the sea. The common Grass-wrack (*Zostera capensis*) can be found in practically every estuary and lagoon along the coast of southern Africa. They can be spotted as large dark patches, or may form sea meadows on the protected sand-banks. The long (or sometimes short, depending on the depth of the water) ribbon-like leaves are well adapted to sway along with the currents. They provide food and shelter for innumerable marine animals. In the Grass-wrack the pollen is filamentous which may be conducive to effective pollination.

Many aquatics are very susceptible to changes in their medium. Increased salinity or pollution will soon kill them, but others, such as the common Hairweed (*Potamogeton pectinatus*) and *Zannichellia palustris,* will thrive in fresh or brackish water. It is no wonder that they have a cosmopolitan distribution even becoming a pest at times by choking up rivers and dams. On the other hand, they provide excellent food for water-birds and plans were made to introduce them into new dams in the Orange Free State. Here the open stretches of water attracted wild geese, but since there was no "water-grass" available, they raided the farmers' lands.

A serious obstacle which all water-plants have to face is desiccation and low winter temperatures. Here various adaptations have been evolved. In some cases survival is achieved by rapid development from seed to seed, the annual life-cycle being completed within a few months. *Ottelia ulvifolia,* common in dams in the northern Transvaal and further north, is an example. *Aponogeton stuhlmannii* is another small plant from the northern tropical parts of Africa; it forms small bulbs that can survive dry periods for years. It inhabits small rock-pools that fill up only after copious rains. In a matter of weeks these bulbs are in leaf and flowering.

A small plant only known from granite rock-pools in northern South West Africa is an amazing example of an aquatic "resurrection plant". It shrivels up completely in dry periods, but after rains it becomes active again in a very short time. More will be written about this intrepid little giant (*Chamaegigas intrepidus*) in another article.

In winter one of our commonest pond-weeds, *Potamogeton thunbergii*, is able to hibernate by the formation of winter buds (turions). These are parts of the root-stock that become swollen with food reserves and develop a corky skin on the outside. When temperatures rise in spring, the winter buds sprout and form new plants. *Potamogeton pectinatus*, mentioned before, and other species also form winter buds.

Dispersal of water-plants is mostly effected by floods or by waterfowl. In most aquatics the flower, lifted above the water during anthesis, is afterwards pulled down by the contracting or recurved flower-stalk, and the fruit ripens near the bottom. Some seeds are buoyant and will come up again and then float about for long periods. Others are never buoyant, or only so for a short period; they could well be dispersed by floods.

That birds play an important part in dispersal cannot be doubted. This is effected either by the seed becoming attached to the bird or by the fruits being eaten and the seeds passing through its alimentary canal. Migrating birds will carry for long distances seeds or bits of the plants among their feathers or clinging to the mud on their feet; this may explain the often erratic distribution of water-plants. *Brasenia schreberi*, for instance, is a very sticky aquatic, and its recent appearance in a part of the Loskop Dam many miles away from localities recorded in Rhodesia and Bechuanaland points to its having been deposited there by birds. Similarly *Najas graminea*, recently found near Pretoria, was only known from the northern parts of Africa, Europe and Asia. *Utricularia vulgaris*, recorded inter alia from Central Africa, has twice been found in the Republic in localities very far apart. The first record was in 1928 from the Transvaal and the last in 1965 from Natal.

In England, many years ago, the nuts of *Potamogeton natans*, a close relative of our species *P. thunbergii*, were fed to a domestic duck in December. The following spring 60% of the seeds that had passed through the duck had germinated compared with only 1% in the control. Water-lily seeds were found in abundance in the stomach of a Jacana. In the flower the seeds are embedded in a jelly-like mass which no doubt is very palatable to the bird.

Mention must be made of a small family, the Lemnaceae, consisting of specialized, free-floating, very tiny plants, the Duckweeds, the smallest flowering plants in existence. In South Africa all four genera that make up the family are represented. Best known are the flat green *Lemna* and *Spirodela* species that form rounded, leaf-like, green bodies about $\frac{1}{4}$ inch in diameter that float on the water. Smaller still, but nearly always found together with the Lemnas, are the green globular Wolffias about the size of a pin-head. A rare genus is the small *Wolffiella*; two of its species were discovered recently in Zululand, the minute ribbon-like *Wolffiella welwitschii* known from Angola and northern Africa and the endemic *W. denticulata* with a filamentous body; in the latter, if floating in quiet waters, the several generations adhere together to form a star-shaped plant about $\frac{1}{4}$ inch in diameter.

Reproduction in the Lemnaceae is nearly always vegetative, the thallus or mother plant bringing forth a younger plant on one side. Very rarely do they produce flowers and fruits. The flower, actually thought to be a reduced inflorescence, is formed in a lateral fold or a dorsal cavity in the thallus and consists of one or two stamens and a carpel containing one or a few ovules. In November, 1965, flowers of *Wolffiella denticulata* were observed for the first time. The fertile plants resembled small mosquito larvae as can be seen on the coloured plate. There is a typical filamentous thallus and a shorter and much broader fertile one. On the upper surface of the latter a cavity appeared inside of which a stamen and a carpel were developed.

At times the Duckweeds can multiply very rapidly (vegetatively) and in a short time cover a stagnant pool or dammed up part of a river to a depth of several inches. The dead masses pollute the water and, unless a good flood washes them away, steps have to be taken to remove them.

Two other curious families are the Podostemaceae and the closely related Hydrostachyaceae that have chosen the most unlikely place for a habitat. They live on the smooth rocks found under cataracts and waterfalls. To remain anchored to their substratum, they have produced special haptera or side-roots that secrete an adhesive type of cement that firmly fastens the plant to the water-worn impenetrable rock. It is believed that the large amount of oxygen present in the rushing water is a *sine qua non* for their existence. Much of interest has been written on their behaviour and adaptations in South America, where they are quite showy and well represented. In South Africa they play a minor role. *Hydrostachys natalensis*, a fairly large fern-like plant, is often seen around waterfalls in Natal.

In conclusion, we would like to refer the reader who wants more information about aquatics to Agnes Arber's book "Water Plants". Here all aspects of the flowering water-plants are dealt with more fully and with much insight; the discussions on natural selection, adaptation, law of loss, etc. provide stimulating reading.

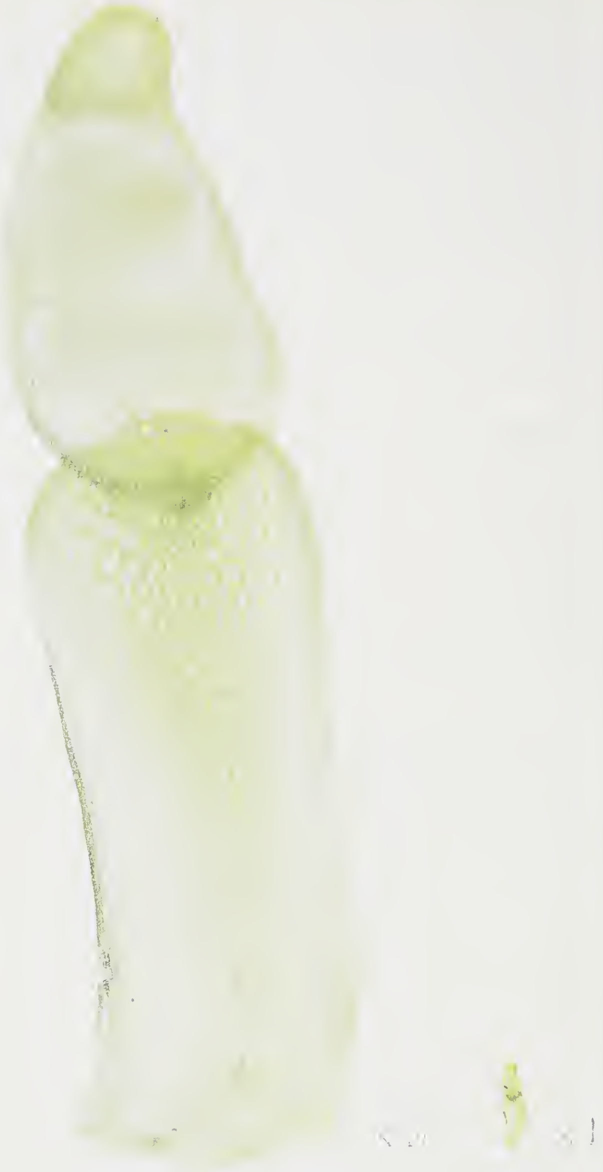

Fig. 1. *Wolffiella welwitschii.*

Thalia Lincoln.

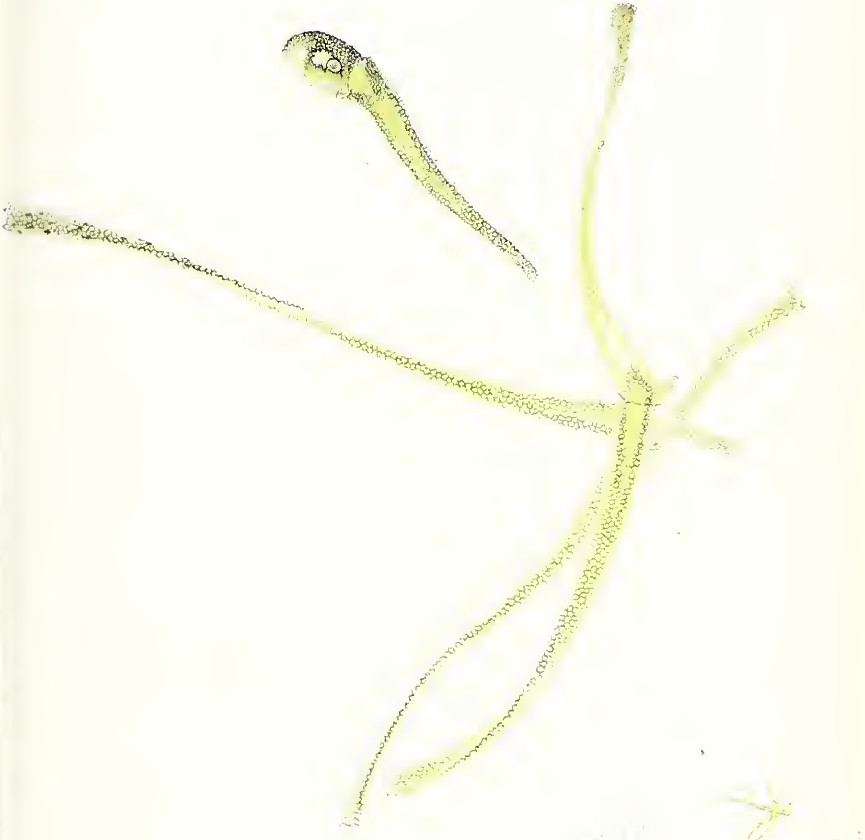

Fig. 2. *Wolffiella denticulata.* Thalia Lincoln.

Resurrection Plants

A. A. Mauve

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WILD plants living in their natural surroundings have been defined by one botanist as "a bundle of adaptations". This is, of course, quite obvious when we consider the number of different requirements needed to survive. The roots need suitable soil, water and air, the stems must be able to channel water and dissolved food up and down from leaf apex to root tip, and they must expose the leaves and flowers in such a way that they can function adequately. The leaves must be able to regulate photosynthesis, water loss and the exchange of gases. The flowers, in need of cross pollination, must find ways and means to achieve this and finally, the fruits and seeds must often invent ingenious ways of dispersal.

Since southern Africa is essentially an arid country, many of our plants fall into the category of xerophytes, viz. plants that have adapted themselves in various ways to dry surroundings; they are able to cope with little water or an irregular supply.

The succulents represent a certain type of xerophyte, for they have reduced their water requirements by a curb on transpiration. Well-known succulents are the Aloes, Euphorbias, Crassulas, Mesembryanthemums (Vygies) and Stapelias, all containing a thick juicy cell sap, their larder in times of drought.

The showy annuals that beckon us to visit Namaqualand in spring after good rains represent another type of xerophyte, They survive the hot dry summer months in the form of dormant seeds, which are produced in their millions and which can withstand desiccation and extreme temperatures for months or even years. Other plants develop large underground food storage organs, such as bulbs and rhizomes. From this reservoir they withdraw the energy to produce leaves, flowers and seeds, but, if droughts prevail, they may remain dormant for years. Too numerous to mention are the many special ways adopted by xerophytes, such as reduction of leaf-size, waxy covers, hairiness, etc.

Some xerophytic plants that we would like to discuss here are the so-called "resurrection plants". They are able to "dry up" during dry spells and then remain in a state of suspended animation or in a quiescent state. In this instance it is the resilience of the protoplasm (the living sap found inside a cell) that is of importance. It is chiefly the lower orders of plants and animals that possess this tough resistance to heat, cold and desiccation to a remarkable degree. The higher orders seem to have lost this characteristic, and it is, therefore, of interest to see it in a flowering plant. In southern Africa we have two outstanding examples, one a terrestial shrub and the other an aquatic herb.

Myrothamnus flabellifolia Welw.

Freely translated the name of this terrestial shrub means "Balsam shrub with fan-shaped leaves". It is common in central and southern Africa and appears to be a pioneer on flat granite or sandstone rock slabs, where it

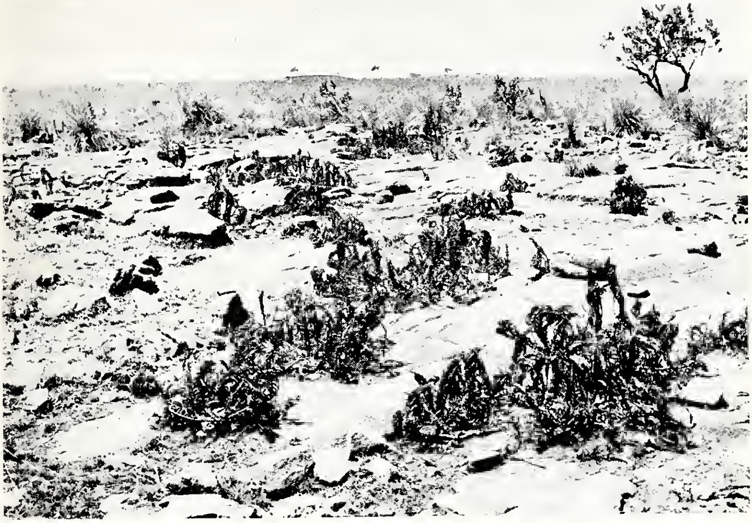

Fig. 1. A group of *Myrothamnus flabellifolia* plants, dormant. Photo: D. Edwards.

roots superficially in the little soil that has accumulated in the crevices.

When seen in dry periods, the plants look most unattractive, dry and grey like dead firewood, with the persistent plicately folded leaves placed close against the branches. Experiments have shown that the young apical parts of the shoots contain only 11 per cent water by weight, whereas in turgid plants (plants saturated with water) the percentage is between 70 and 75 per cent (Child, 1960). Thoday (1920) recorded an even lower figure, since he found the water content to be only about 7 per cent when dry.

When, however, good rains have fallen, the plants become active in a very short time. The leaves unfold exposing the bright green interior. Experiments show that the water is absorbed by the roots through the woody stems and that the upward flow is stimulated by the leaf (Child, 1960).

If a leaf is examined, it will be seen to possess 3 (occasionally 5) strong raised ribs between which are softer grooves. In these green grooves the breathing pores or stomata which ventilate the inner tissues are situated. The outer skin of the ribs consists of thick-walled larger cells devoid of pores but with scattered thin-walled resin glands. The latter are more numerous on the upper surface, and it is thought that the exuding resinous sap helps to protect the leaf against desiccation and also infections. When the leaf closes through loss of water, the ribs meet and cover the vulnerable tissues so that further loss of water is averted (Grundell, 1933). Grundell was able to revive specimens kept in the herbarium for 18 months and experiments showed that the protoplasm was still alive.

The aromatic resin found in *Myrothamnus* makes it unpalatable to grazing animals but it is in great demand by the Bantu, who use it as a medicinal tea or mix it with fat to make an ointment.

Chamaegigas intrepidus Dinter ex Heil

The second "resurrection plant" is a small flowering water-plant that has attracted much attention. It is found only in South West Africa, north of Windhoek, and was collected for the first time in 1909 by the famous German plant collector Kurt Dinter. He discovered it in shallow rock pools in granite outcrops on the hills near Okahandja. These hollows in

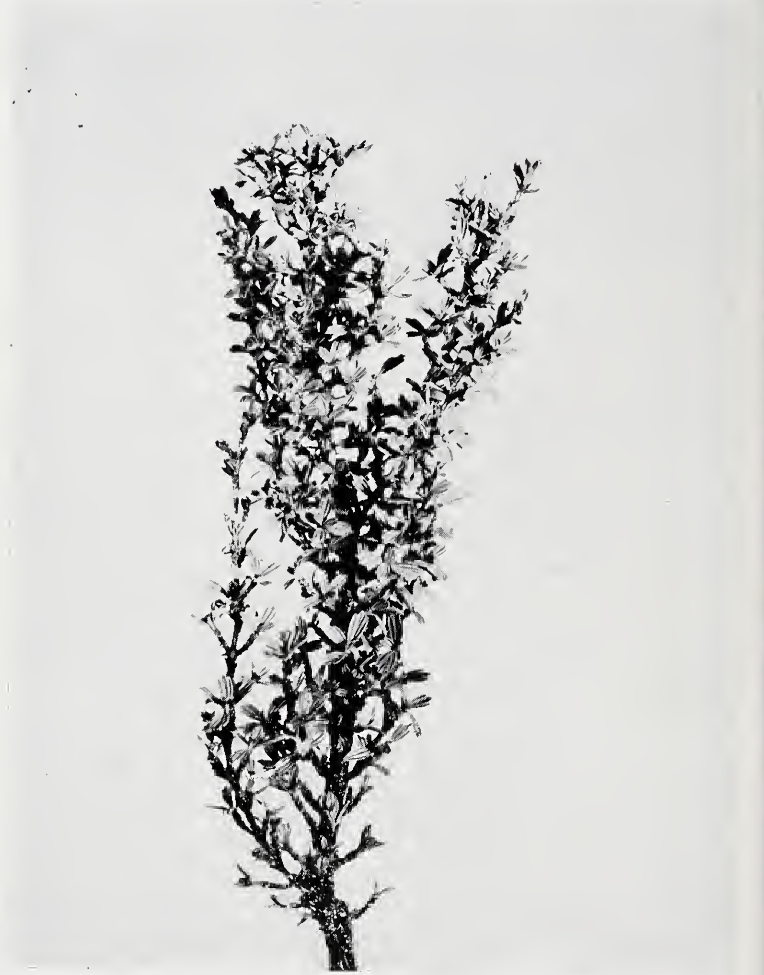

Fig. 2. *Myrothamnus flabellifolia,* active. Photo: J. Reyburn.

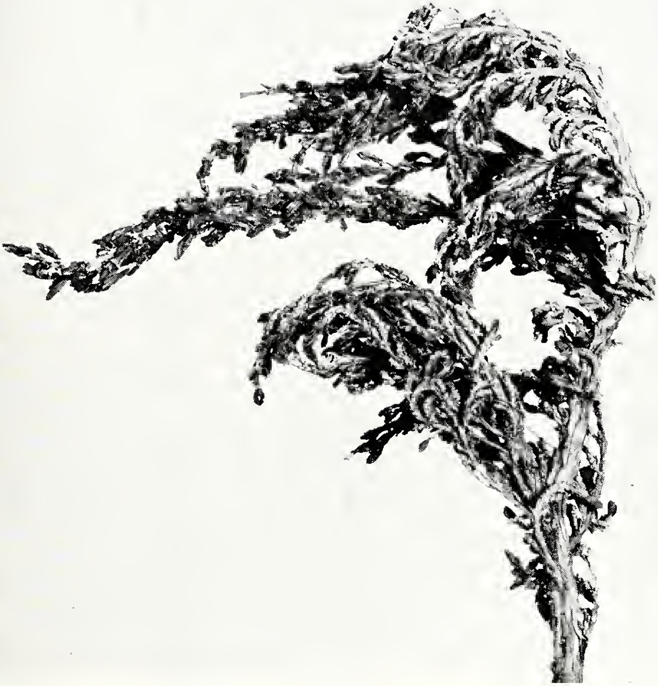

Fig. 3. *Myrothamnus flabellifolia,* dormant. Photo: J. Reyburn.

the rocks fill up with rain-water after a good downpour; the largest of them may then perhaps contain a few gallons of water. When dry, the bottom of such a pool is covered with a thin layer of coarse sand, animal excrement, dead insects, algal wool, etc. In this layer the dry, tiny, irregular rhizomes, or compact bases of *chamaegigas intrepidus* lie dormant. Dinter gave the plant this name, meaning Intrepid Little Giant, after watching its resurrection after rains had filled the hollows. In a very short time the shrivelled needle-shaped leaves stretch and swell up to ten times their size, the tips turning green. In a few days a long, thin, thread-like stem will display 2 pairs of opposite floating leaves and one or two pretty *Salvia*-like flowers above.

If we consider the conditions that prevailed perhaps only six days previously, the extreme dryness of the atmosphere and the hot sun baking on the exposed stones heating them up to 50°C and more, we realize what a resilient little giant this minute plant can be.

The two plants mentioned above are, of course, very striking examples, but perhaps some day plants which "resurrect" unobtrusively may also be discovered.

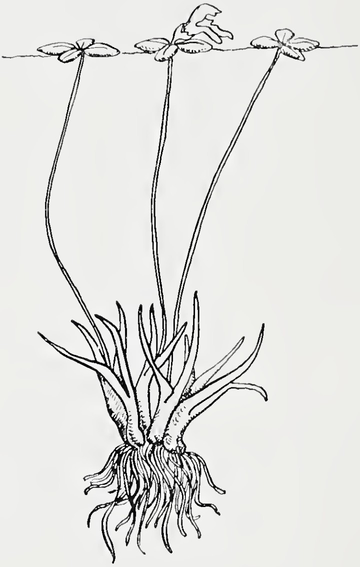

Fig. 4. *Chamaegigas intrepidus.*

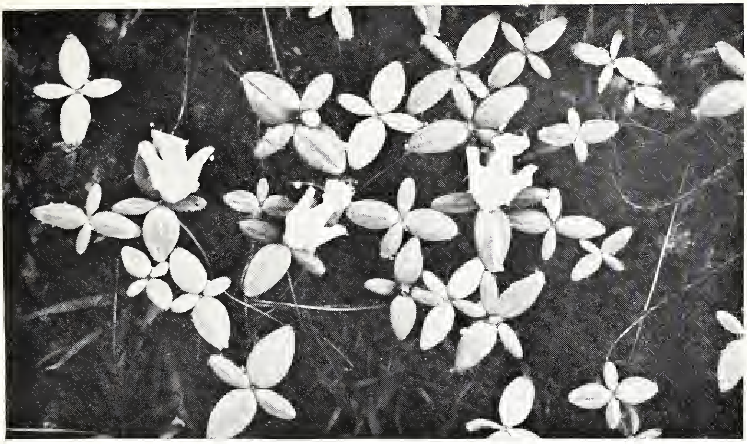

Fig. 5. *Chamaegigas intrepidus*. Photo: B. de Winter.

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Home range of the Leopard Tortoise

(*Geochelone pardalis* (Bell))

in the S.A. Lombard Nature Reserve, Bloemhof, Transvaal

J. H. M. van Zyl

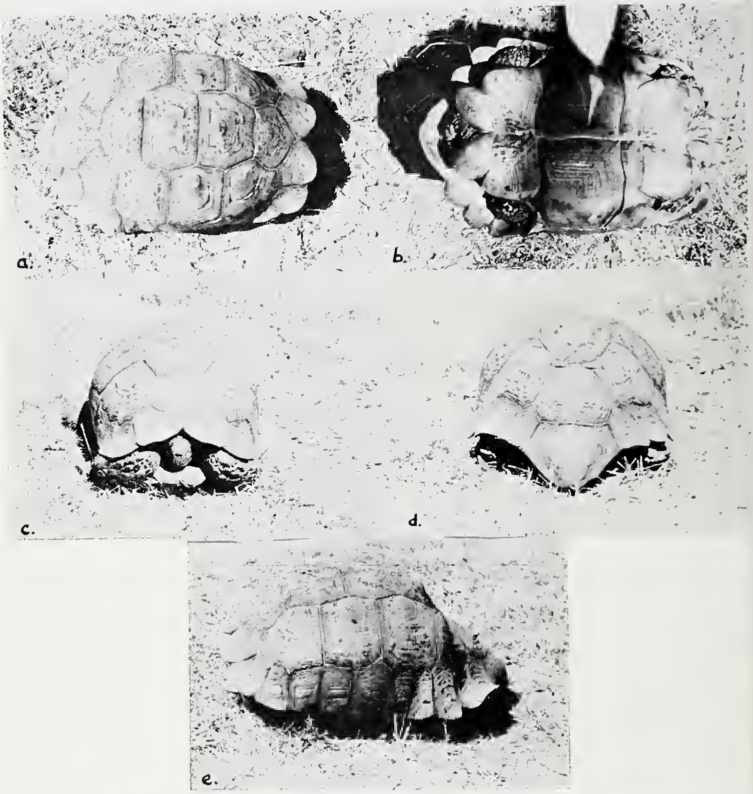

Fig. 1. A male Leopard Tortoise photographed in the S.A. Lombard Nature Reserve. (a) Dorsal, (b) ventral, (c) anterior, (d) posterior and (e) lateral view.

HEWITT (1937) makes the following statement about the habits of the Leopard Tortoise: "There is a pronounced homing instinct, and apparently they do not travel very far from home; . . ." To test the validity of this statement, specimens found in the S.A. Lombard Nature Reserve have been marked since 1958 and released either at the office in the reserve or in the animals' original surroundings. Metal tags with the date of capture were fixed to the left hind margin of the carapace for identification purposes (Fig. 1a). No two animals were tagged with the same date.

Distribution:

The Leopard Tortoise and the Cape Terrapin (*Pelomedusa subrufa*) are the only two members of the group that inhabit this area. Both types have a wide distribution in Southern Africa (Hewitt, op. cit.; Rose, 1950). Wermuth et. al. (1961) still use the generic name *Testudo* when describing *Geochelone pardalis*. This species, commonly known as the Bergskilpad amongst Afrikaans speaking residents, is fairly common in its distribution from the dry Kalahari-Thornveld in the West through the Orange Free State and Karroo into the Eastern Province, where there is a much higher rainfall, such as the Albany district (Hewitt, op. cit.). It does not occur in the south-west corner of the Republic nor in forest areas (Rose, op. cit.). Its habitat is mostly stony bush-covered hills and the open grass-veld of the countryside, but suitable cover against summer heat is essential (Hewitt, op. cit.). At least four fresh skeletons were found during and after the severe drought of 1965/66 in this reserve with an area of about 5,000 morgen.

Structural characters:

The carapace or dorsal body shield is strongly arched (Fig. 1), but variations are frequent. Its anterior margin is deeply notched over the neck and the same applies to the hind border of the plastron, or ventral body shield, in the male animal. The male's carapace is not as strongly arched as that of the female (Hewitt, op. cit.) and is narrower from side to side compared with a female of the same size. Along the anterior and posterior cavities of the carapace the rim is more strongly everted in the male. The colour of the carapace is yellowish with numerous black lines, spots and blotches arranged in a radiating fashion on the central shields. In older specimens the pattern fades and becomes more or less plain (Hewitt, op cit.). It was observed that specimens obtained about fifty miles to the west of the Lombard Nature Reserve during the course of this study were mostly rusty-brown with black spots, so that there may be variations in colour due to geographic distribution.

The horny upper jaw forms a prognathic "denture" which occasionally ends in spike-like outgrowths resembling canine teeth.

The bony plates of the carapace are always constant with three large ones in the middle line running longitudinally, surrounded by ten large shields that are bounded along the margin of the carapace by numerous smaller ones. The sutures between the horny shields do not correspond with those of the body plates beneath them; this is in contradistinction to a statement by Hewitt (op. cit.), who says that the marginal horny shields correspond with the bony plates below them. Although the oval shape of the carapace with a fairly smooth curve is common in this genus, variations do occur. Thus the dorsal shields may be raised into conical eminences, but these are not as prominent as they are in the Geometric group of tortoises.

The male's plastron is concave, especially towards the posterior part of its surface, and this is of importance during copulation. (Fig. 1.) His tail is also much longer than that of the female.

Body weight:

In practice it was not possible to weigh each specimen, but it seems as if the weights of the adults varied between 12 and 21 pounds (Table 1). A female weighing 13 lbs 1¼ oz. on 1.10.1962 was recaptured on 29.3.1966 and then weighed 16 lbs 12½ oz. indicating a definite increase in body weight. Another female, however, weighed 12 lbs 13¾ oz. on 22.8.1960, and when recaptured on 25.3.1963 had slightly decreased in body weight to 12 lbs 5 oz. It seems, therefore, as if the adult's weight is not less than 12 lbs. In the literature body weights of 50 lbs are reported, e.g. in the Eastern Province (Hewitt, op. cit.; Rose, op. cit.). It is possible that the body weight may be influenced by geographical distribution. Although no data exist about the age of the animals discussed, the following table may be of interest.

Table 1: Body weights of the Leopard Tortoise (*Geochelone pardalis* (Bell)) and the number of recoveries of each specimen in the S.A. Lombard Nature Reserve, Bloemhof, Transvaal.

MALE			*FEMALE*		
Body weight		*Number of times recaptured*	*Body weight*		*Number of times recaptured*
lbs.	*ozs.*		*lbs.*	*ozs.*	
16	0	3	20	0	5
14	2	3	13	½	4
16	11¼	2	12	13¾	4
16	11¾	1	21	4¾	1
13	0	1	14	2½	—
12	8	1	16	12½	1
15	6	—	21	4	1
14	2	—	16	0	—
11	6	—	0	11	—
6	12¼	—	9	8	—
6	14	—	3	9	—
6	10	—	1	10	—
			1	0	—

From Table 1 it is obvious that no animal weighing less than 12 lbs was recovered. It might be inferred that on account of their size the smaller ones are not as easily seen in the veld as the heavier and larger ones. But it needs an experienced observer to find the tortoises in the tall grass normally present in this reserve. The possibility of heavy losses among the sub-adults must be borne in mind. In this connection Hewitt (op. cit.) mentions quite a number of species that prey on these tortoises. But the sub-adults may lead a nomadic way of life. A case in point is that of a young female tortoise weighing six lbs, which was recovered after thirty-seven days more than five miles away from the point at which it was tagged and released.

Food:

Hewitt (op. cit.) states that Leopard Tortoises feed heavily during the summer months, but in the coldest winter months they hibernate to a greater or lesser extent. According to Rose (op. cit.), the favourite food is succulents such as cotyledons, while Hewitt (op. cit.) records grass, succulents, crassulas, spekboom, thistles, prickly pear, and also pumpkins, water-melons and beans when obtainable, and even bones, dry dog faeces and owl-castings. To this list can be added *Tribulus terrestris* (Devil's Thorn or dubbeltjie), *Cynodon dactylon* (Kweekgras), *Themeda triandra* (Rooigras) and *Bulbine* species of this area (van Zyl, 1965). Their ability to digest grasses seems to be fairly low, since their droppings contain mostly grass leaves in a perfectly natural shape (Fig. 2). In the North-

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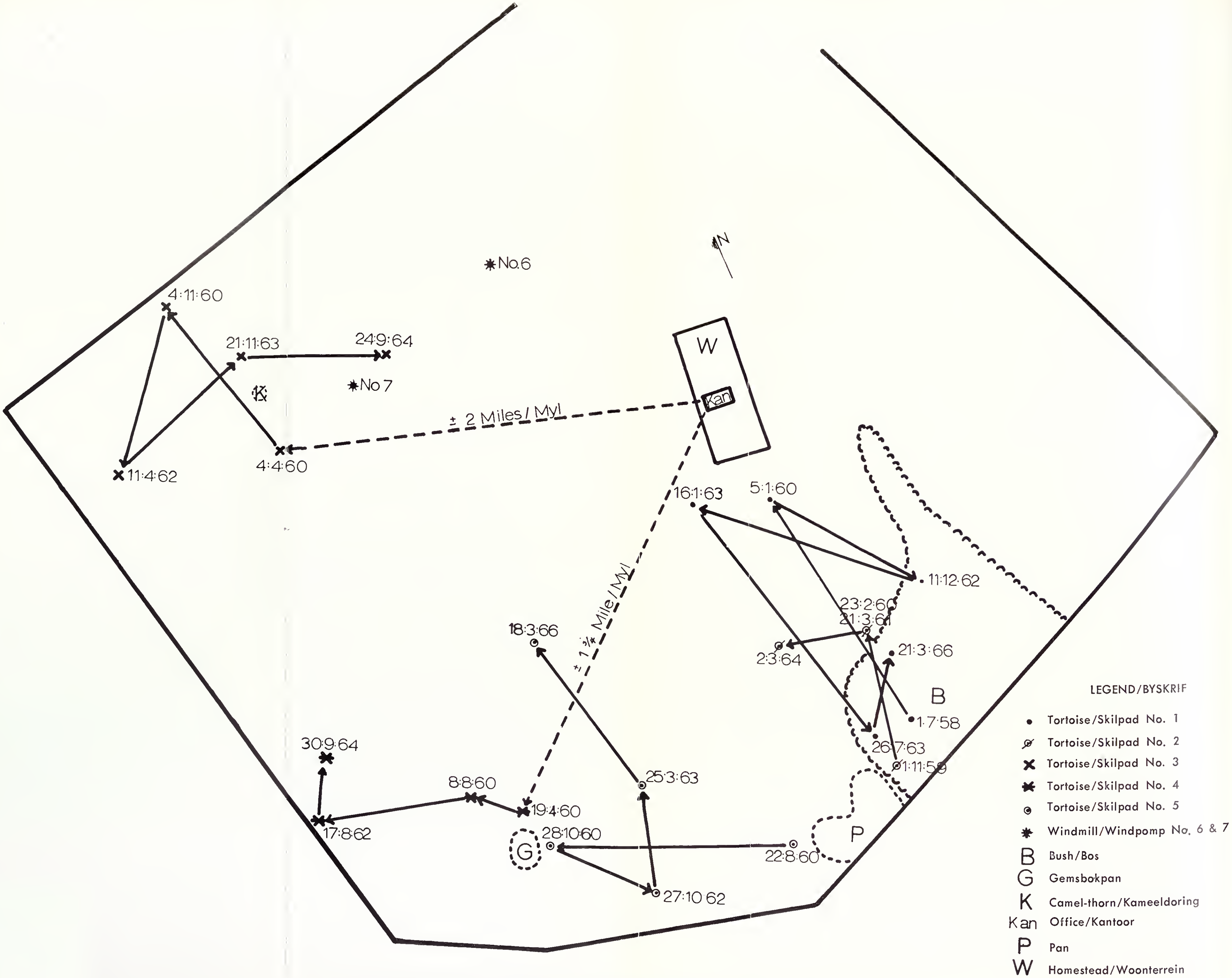

Fig. 3. Diagramatic representation of the home range of the Leopard Tortoise (*Geochelone pardalis*) in the S.A. Lombard Nature Reserve, Bloemhof, Transvaal.

western Cape this tortoise can survive for long periods in captivity on the leaves of *Cotyledon wallichii* (Krimpsiektebos), which is deadly poisonous to the domestic goat.

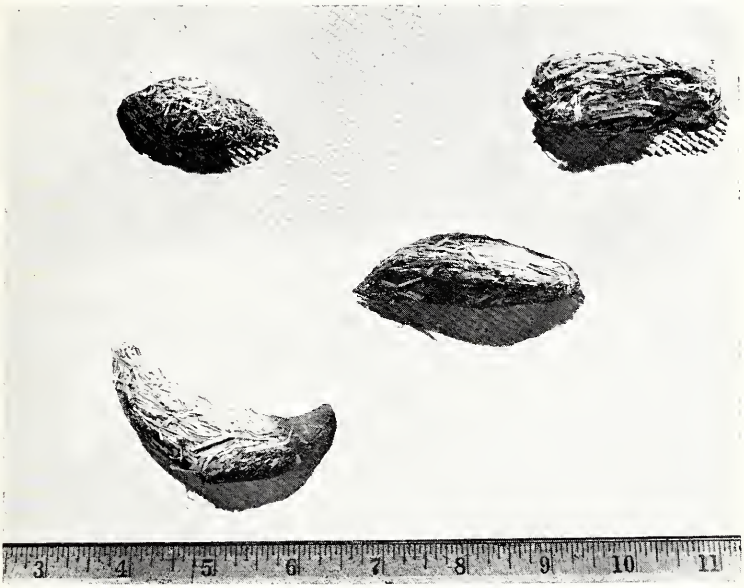

Fig. 2. Excrement of the Leopard Tortoise.

Home Range:

According to Hewitt (op. cit.) the Leopard Tortoise has a definite home range and is able to find its way back even after it has been taken several miles away; it takes up the same winter quarters every year. Except for two records during the present study, Leopard Tortoises were never recorded during the winter months of May, June and July. Both these recoveries were, however, made in dense bush, probably their winter quarters.

Rose (op. cit.) tells of the fabulous homing instinct of a Beaufort West tortoise which is alleged to have returned home from Marico, a distance of 500 miles in three years time.

The observations carried out over a period of eight years in this nature reserve (1958-1966) confirm statements about their partiality for certain territories, and also that they have a homing instinct. Four of the five specimens discussed above (Fig. 3) found their way back home over a distance of one half to two miles in a relatively short time. It seems that they keep to their home range and never leave it. This applies to both sexes. It is also interesting that Nos. 1 and 2 (a male and female respectively) remained in the same territory for at least five years, but no records for the male exist since 1964. According to present data the male occupies a smaller range than the female (Fig. 3).

ACKNOWLEDGEMENTS

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Embryonic Implantation in the Springbok

(*Antidorcas marsupialis marsupialis* (Zimmermann))
and ovulation in the S.A. Buffalo (*Syncerus caffer caffer* (Sparrman))

In the S.A. Lombard Nature Reserve, Bloemhof, Transvaal.

J. H. M. van Zyl

ONE HUNDRED AND FORTY-FOUR female reproductive tracts of the Springbok were examined in this nature reserve in 1962. Pregnancy was observed in 117 cases, and follicles or corpora lutea in 24 others. Only three animals showed no signs of reproduction.

In all cases the single embryo was implanted in the right uterine horn, and the latter was also larger in the 24 cases which had no embryos although there were signs of pregnancy. Similar observations have been reported for the Uganda Kob (*Adenota kob*) (Buechner, 1961), the Grey Duiker (*Sylvicapra grimmia*) (Child, 1965), the Impala (*Aepyceros melampus*) (Mossman and Mossman, 1962), and the Lechwe (*Kobus leche*) (Robinette and Child, 1964).

Copora lutea or follicles were observed in 95 ovaries. In these 58 right ovaries were active against 37 on the left side. This is different from what is reported for the Grey Duiker, where the left ovaries seem to be more active (Child, 1965). In the case of ten impalas examined in this nature reserve, all but one showed that activities were limited to the left ovary.

Ovulation varied in the case of two S.A. Buffalo heifers examined in the nature reserve during twelve months. Sixteen oestrus cycles occurred during this period in both cases. Ovulation took place twelve times in the left ovary of the one buffalo (aged seven years) and was repeated up to four times in succession in the left ovary. In the other animal (aged four years) the number of follicles developed during the period of twelve months was the same on both ovaries, but it was also observed that ovulation was repeated four times in succession in the left ovary.

To sum up, it seems that although implantation of the embryo is restricted to the right uterine horn in the game animals discussed, ovulation is bilateral but varies amongst species and even in the same species between left and right.

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Coccidiosis in Antelopes

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MOST PEOPLE who have been involved in the raising of young domesticated animals such as chickens, calves, puppies and lambs will have had some experience of an intestinal affliction called coccidiosis.

Coccidia are minute unicellular parasites belonging to the phylum Protozoa and class Sporozoa of the Animal Kingdom. They have a fairly complicated life-cycle. Most of them live in the cells of the intestinal tract of their hosts, where they multiply extensively during the early asexual phase of the life-cycle. A sexual phase, also spent intracellularly, follows resulting in the formation of resistant oocysts which pass out of the body with the faeces. These oocysts have thick walls, consisting partly of quinone-tanned protein, which enable them to survive unfavourable climatic conditions and make them resistant to most disinfectants. If the microclimate is suitably moist and warm and there is sufficient oxygen present, the oocysts ripen, or sporulate, to contain sporocysts. When such fully sporulated oocysts are ingested by a suitable host, sporozoites are liberated from the sporocysts by the action of digestive juices, and these invade intestinal cells to repeat the life-cycle.

Coccidia may harm their hosts in various ways. During the process of intracellular growth and multiplication of these parasites in the intestinal tract the host cells are destroyed, leading to impairment of the normal functions of digestion and absorption of food. At the same time the very efficient epithelial barrier of the gut is opened up to invasion by bacteria. Some coccidia cause severe haemorrhages by destroying the walls of blood vessels. It is, therefore, not strange that they may cause severe illness and even death if present in large numbers.

Coccidia are an extremely successful group parasitizing a wide variety of animals including the lowly millepede and man himself. They are well equipped to survive outside the body and rarely kill off their hosts before a great many parasites have reached the oocyst stage and have escaped via the faeces.

Most coccidia, i.e. those of the genus *Eimeria*, are host-specific. Coccidia of cattle, for instance, do not parasitize sheep, dogs, fowls etc. This rule apparently only breaks down in closely related species like sheep and goats.

As domesticated animals were developed from wild animal ancestors, one would expect coccidia in the latter. This has already been found to be the case in a fairly wide variety of wild animals living in captivity as well as in a natural environment. There is every reason to believe that coccidia will eventually be found in most metazoan species of animals.

Only a few coccidia have been described from African antelopes to date, viz. from the Eland (Triffit, 1924; and Yakimoff, 1934), Waterbuck (Yakimoff & Matschoulsky, 1938) Gerenuk, Blue Wildebeest (Prasad, 1960) and Kongoni (Prasad & Narayan, 1963). Coccidia have also been found in the Springbok, Duiker and Mountain Reedbuck (Bigalke, unpublished). These descriptions have been based on the morphology of oocysts found in faeces specimens. The extremely important intestinal stages which determine the pathogenicity of the parasite concerned are still unknown.

Until fairly recently this also applied to *Eimeria impalae* (Prasad & Narayan, 1963), described from East African impalas. An opportunity to study the intestinal or endogenous stages arose subsequent to the capture and confinement to a small paddock of a group of young impalas (four to six months of age) for quarantine purposes. Within three weeks 17 out of 25 animals had died. An autopsy performed on one of these provided good evidence that coccidiosis was the cause of death (Pienaar *et al*, 1964). A severe enteritis of the small intestine was associated with very heavy parasitization of the gut wall. In some places normal tissue had been completely obliterated by parasites which were all in the sexual stage of the life-cycle. Histological examination of affected gut obtained from six more fatal cases showed essentially the same picture (Figs. 1, 2 & 3). It appears, therefore, as if the sexual stages are the most pathogenic ones in the life cycle of this parasite.

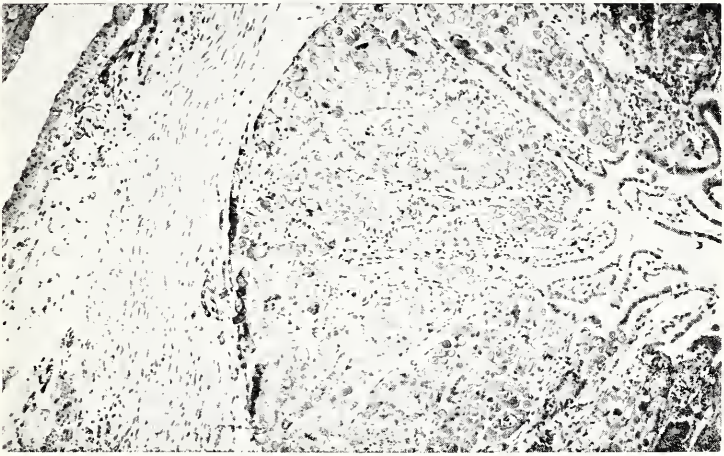

Fig. 1. Small intestine showing massive infection of the mucosa. X 75.

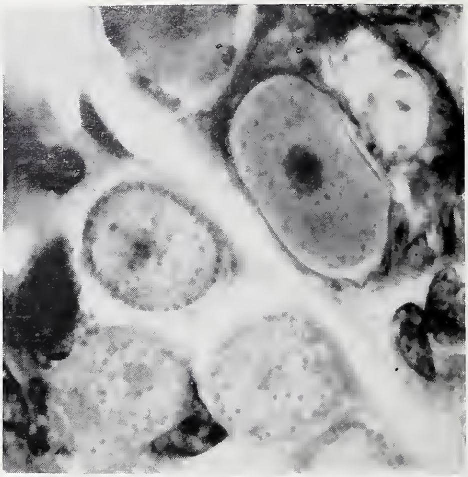

Fig. 2. High magnification showing structure of three macrogametocytes on lower left, and single young oocyst on upper right. X 1,200.

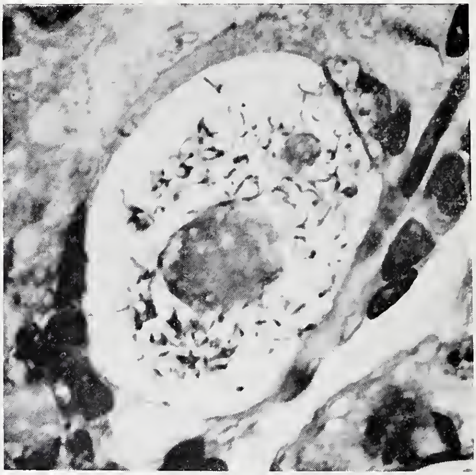

Fig. 3. High magnification of a mature microgametocyte containing microgametes and a central residual body. X 1,200.

Faeces obtained from some of the impalas before and after death contained very large numbers of oocysts. These were all so similar morphologically that it was obvious that a single species of *Eimeria* was involved. Furthermore, they resembled *E. impalae* so closely that it can be accepted that they were the same parasite (Bigalke, 1964).

On the strength of the well-substantiated host-specificity of *Eimeria* spp., and the fact that nothing resembling *E. impalae* has been found in domesticated animals, it can be safely assumed that *E. impalae* is specific for impalas. This assumption calls for an explanation of the sudden "appearance" of this highly virulent parasite.

Under conditions of extensive management, where exposure is limited, coccidia are rarely responsible for disease. When susceptible young animals are, however, crowded together under climatic and hygienic conditions allowing a build-up of ripe young oocysts in the soil, disease can be expected. There is little doubt that in this instance a similar situation arose. In a natural environment impalas do probably not become infected with many oocysts of *E. impalae*. Consequently little harm is done, and unless one were to examine excreta regularly for oocysts the infection would pass undetected. In this instance, however, conditions conducive to an outbreak of coccidiosis were created by confining the animals to close quarters. Oocysts were probably introduced into these quarters by one or more impalas acting as symptomless carriers. *E. impalae*, which is obviously a highly pathogenic parasite, soon multiplied extensively and wrought havoc amongst the youngsters.

It is very likely that other coccidia, not necessarily as pathogenic as *E. impalae*, will also be found in impalas. Other antelopes probably also harbour a series of different *Eimeria* spp. Some of these may never have had the opportunity to demonstrate their pathogenic potential. It would be well to be aware of this at a time when translocation of game, inevitably tied up with enforced quarantine periods, is becoming increasingly important.

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TRANSVAAL
TUA CONSERVA

1947 — 1967

The Nature Conservation Branch of the Transvaal Provincial Administration has now completed the first two decades of its existence.

The Hononrable S. G. J. van Niekerk, Administrator of the Transvaal, at the helm of the "Impala" in the Loskop Dam Nature Reserwe.

Photo: J. Balcomb

FAUNA & FLORA

AN OFFICIAL PUBLICATION OF THE TRANSVAAL
PROVINCIAL ADMINISTRATION

The opinions expressed in this bulletin are not necessarily those of the Nature Conservation Branch nor of the Administration.

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Twenty Kinds of Transvaal Timbers

C. P. Kromhout
Forest Research Institute, Pretoria

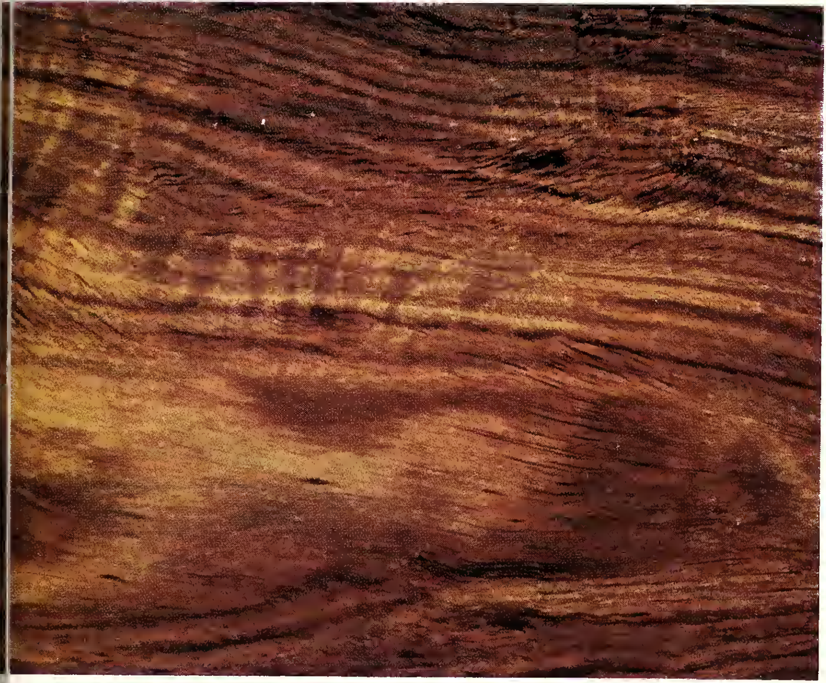

Fig. 1. Tambotie wood.

INTRODUCTION

Some of the finest timbers are to be found in the Transvaal. Woods such as tambotie, kiaat, red ivory and wild olive are world-famous and very valuable. Unfortunately so few of these trees are found in consolidated forests that the timbers cannot be utilized commercially. The trees found on farms are usually wisely protected and used with discretion by farmers who do not lend themselves to large scale eradication of their timber by wood-cutters.

The Kruger National Park contains an inestimable wealth of flora and a large variety of trees. One needs only to refer to Dr. Codd's well-known "Trees and Shrubs of the Kruger National Park" to get some idea of all the species to be found there. This timber is, of course, inaccessible for utilization, as the trees constitute part of the ecosystem of the National Park.

Although the available supplies of indigenous timber amount to great quantities in toto, the wood cannot be economically exploited because of its scattered occurrence. Hence furniture made from various kinds of Transvaal wood is virtually rare and commands collectors' prices.

Occasions do, however, arise when large areas or strips must be cleared for water schemes, the making of new roads and similar projects. With a little effort and enterprise some of the fine wood, that would otherwise be wasted, could be obtained and turned into the finest furniture or a collection of ornaments from one of nature's most beautiful creations.

The excellent book of B. de Winter, Mayda de Winter and D. J. B. Killick entitled "Sixty-six Transvaal Trees" furnishes much information about the kinds of trees, their distribution, form and size, names, relationships with other species, utilization, propagation and so forth. To make this account complete, brief descriptions are given of the trees and their distribution, and special attention is paid to the wood and its uses.

No original data about the wood and trees are furnished. Instead of this, photographs of the various kinds of wood are included, something that has not yet been done in this journal.

Data from which the article has been compiled have been drawn from various publications, a list of which appears at the end. In the text the source of facts and reports is not always indicated, but constant use has been made of all the publications, and the availability of so many particulars has greatly facilitated the task.

The order in which the woods are described is the following:—

TAMBOTIE	*Spirostachys africana* Sond.
KIAAT	*Pterocarpus angolensis* DC.
RED BEECH	*Faurea saligna* Harv.
WILD SERINGA	*Burkea africana* Hook.
CAMDEBO STINKWOOD	*Celtis africana* Burm. f.
TREE FUCHSIA	*Schotia brachypetala* Sond.
MARULA	*Sclerocarya caffra* Sond.
MATUMI	*Adina microcephala var galpinii* (Oliv.) Hiern.
MTSERIE	*Bridelia micrantha* Baill.
MOPANE	*Colophospermum mopane* (Kirk ex Benth.) Kirk ex J. Léonard.
RED IVORY	*Phyllogeiton zeyheri* (Sond.) Suesseng.
KNOB-THORN	*Acacia nigrescens* Oliv.
UMVANGHAAS	*Albizia versicolor* Welw. ex Oliv.
FOREST SILVER TREE	*Brachylaena discolor* DC.
NATAL MAHOGANY	*Trichilia emetica* Vahl.
PIGEON WOOD	*Trema orientalis* (L.) Blume.
KAFFIR TREE	*Erythrina lysistemon* Hutch. and *Erythrina caffra* Thunb.
FEVER TREE	*Anthocleista zambesiaca* Bak.
TRANSVAAL EBONY	*Diospyros mespiliformis* Hochst. ex A. DC.
WHITE SERINGA	*Kirkia acuminata* Oliv.

All the photographs were taken by J. L. Kriel, photographer of the National Film Board, and the illustrations represent actual sizes.

This article is published with the consent of the Secretary for Forestry.

TAMBOTIE

Sprirostachys africana Sond.

Standard Name: Tambotie.

Tambotie is found in the savanna woodlands of the Transvaal and Zululand and the northern parts of South West Africa, usually in small clumps. The trees are usually 20-30 ft. high with straight clean trunks that may attain a diameter of 18 in.

The average size of logs is comparatively small, 8 ft. in length and 12 in. in diameter. Frequently the heart-wood is decayed or hollow, and smaller logs have cracks through the centre. It is difficult, therefore, to obtain sound broad planks.

The wood is hard but oily, and the logs are not difficult to saw. Planks dry well but very slowly, and it takes two to three months to air-dry one inch boards. Surface checks sometimes appear.

The sap-wood is light to dark yellow and the heart-wood brown to dark brown with black streaks. The heart-wood does not appear very mottled or streaky but rather dignified and durable.

Air-dried wood weighs 60 pounds per cubic foot on the average and is, therefore, heavy as well as hard and strong.

The grain is straight or sometimes wavy and always very fine and smooth.

The wood is difficult to saw and plain and the grain lifts or chips, although hardly any trouble is experienced when it is planed in the direction of the grain. The oiliness of the wood makes it easier to work than other woods of comparable hardness. The wood can be neatly bored, well mortised and turned, but is difficult to sand owing to clogging of the sandpaper. Gluing must receive special attention; owing to the oiliness, surfaces that are to be glued must first be cleaned with benzine or spirits. Or through mortises can be made and the tenons fixed by means of wedges.

The heart-wood is exceptionally hard and durable, but not the sapwood; hence immersion in an emulsion containing benzene-hexachloride is recommended before stacking newly sawn planks.

Tambotie is used mainly for high-grade articles of furniture and cabinet work. Its utilization is rather restricted owing to the small supplies and the natural defects in the logs.

Identification.

The characteristic fragrance when the wood is freshly worked or scraped greatly facilitates identification. It is of a particularly fine texture and heavy, and the vessels are hardly visible to the naked eye on a clean-cut transverse surface.

KIAAT

Pterocarpus angolensis DC.

Standard Name: Kiaat.

Kiaat is a common tree of the Transvaal Low Veld and is also found in the northern parts of South West Africa, North Zululand, Botswana, Rhodesia and Zambia. It thrives best and is more abundant in Mozambique.

The trees are often 30-45 ft. high with a trunk 12 in.-24 in. in diameter. Large logs are cut in Mozambique, but Transvaal trees seldom produce logs longer than 12 ft. and thicker than 18 in.; they are usually crooked.

Logs saw easily and boards dry particularly well in air-drying stacks or in drying kilns. Thick beams sometimes develop surface cracks, especially those sawn from the boundary zone between the heart and sap-wood.

The sap-wood is yellow and the heart-wood brown to reddish-brown with lighter and darker streaks. The heart-wood is sometimes particularly red in colour, whereas some trees produce a very light brown wood. The streaky appearance of the wood is usually very conspicuous and variegated, and generally the figure is most attractive.

The grain of Kiaat, especially that of Transvaal origin, is seldom straight, mainly because the boards have been sawn from fairly crooked logs. The texture appears to be coarse as the result of the presence of some large vessels, but otherwise it is medium.

Transvaal Kiaat weighs 41 lbs. per cubic foot on the average, whereas that of South West African origin weighs only 28-30 lbs. The Transvaal Kiaat has an ideal weight for furniture and adequate strength, but Kiaat from South West Africa is usually too light and soft for ordinary furniture, except for wardrobes, panels and shelving, where hardness is not so important.

Kiaat works easily, makes good glue joints, turns reasonably well and sands reasonably smooth.

The sap-wood is very susceptible to beetle attacks, but the heart-wood is very durable for all normal uses to which it is put. Planks should be immersed in a suitable insecticide before stacking for air drying to prevent beetle attacks while drying.

Kiaat is used for furniture, floors, office counters and finishing, panels and partitions, veneering (mainly for the outer layers of plywood), high-

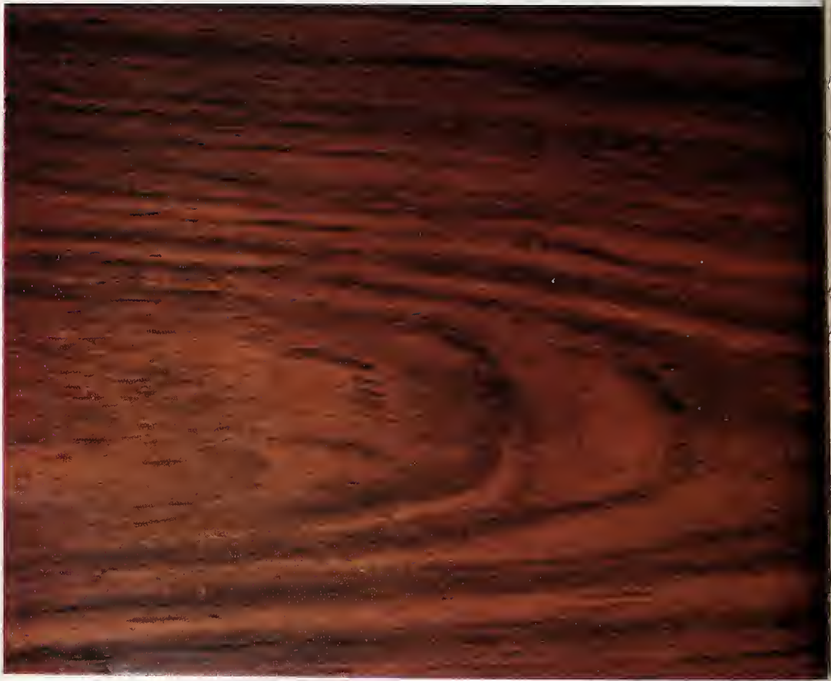

Fig. 2. Kiaat wood.

grade window-sashes, frames and doors. It is especially suitable for use where stability counts, in other words where the wood must not shrink or swell much with changes in humidity. In this respect Kiaat compares favourably with teak and mahogany.

Identification.

Kiaat has a very characteristic odour when being worked. On a clean-cut transverse surface the wavy soft tissue and the sparsely distributed large vessels are the most striking characters.

RED BEECH

Faurea saligna Harv.

Standard Name: Rooiboekenhout.

Red Beech is abundant in the Transvaal bushveld and Low Veld and is also to be found in Zululand and Natal.

The trees are of medium size, approximately 25 to 30 ft. tall and 8 to 15 inches in diameter. Logs of these thicknesses and 6 to 10 feet in length can be made, but they are crooked. There are many natural defects such as decayed heart and knots, and the logs must be sawn into planks as soon as possible in order to prevent excessive loss through splitting.

The logs are easily sawn into boards on a suitable machine and the

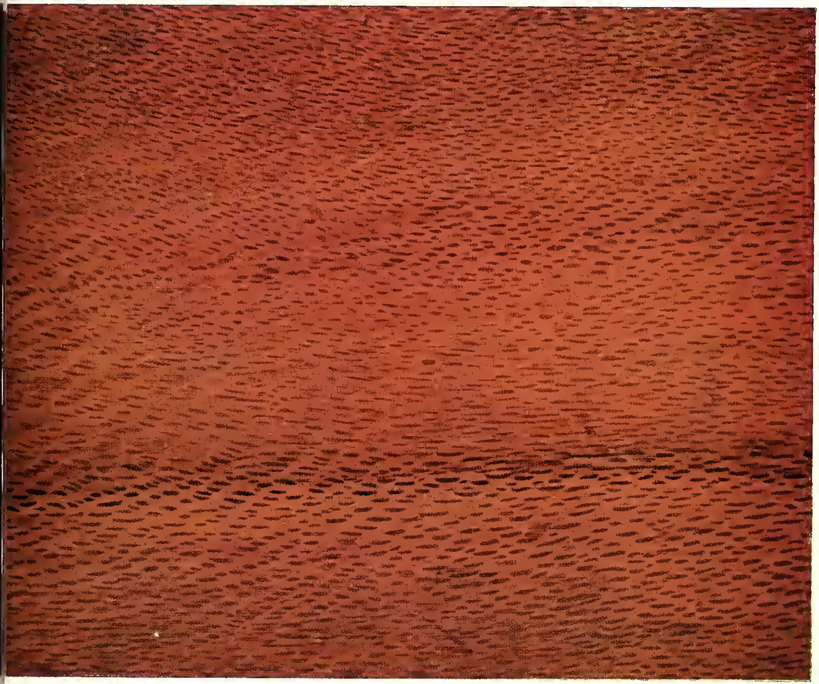

Fig. 3. Red Beech wood

wood dries fairly well, although surface checking and some corrugation occur.

The heart-wood is brown to dark-brown, often with a pinkish tint. The sap-wood is lighter in colour. The broad rays are the most striking characteristic of the wood. They are darker in colour than the ground tissue and appear reticulate on the wood surface. On quarter sawn boards the medullary rays form broad long flecks similar to the silver grain of oak wood.

The grain seldom runs straight over a long distance and the texture is medium to medium fine although it appears coarse because of the large rays.

Air-dried wood weighs 48 (40-57) lbs., and is, therefore, heavy and strong, but nevertheless works easily, makes good mortises and glues well. The medullary ray tissue is inclined to lift on radial surfaces.

Red Beech is proof against termites and fungi and is suitable for poles and other outdoor work. The sap-wood is not durable.

Uses. Poles, furniture, turning, picture rails, floor blocks.

The wood has no characteristic odour. The broad rays, brown colour, and the vessels and soft tissue that are arranged catenately between the rays on a clean-cut transverse surface facilitate identification.

WILD SERINGA

Burkea africana Hook.

Standard Name: Wildesering.

The Wild Seringa grows in the central and northern Transvaal, Botswana and the northern parts of South West Africa and extends into

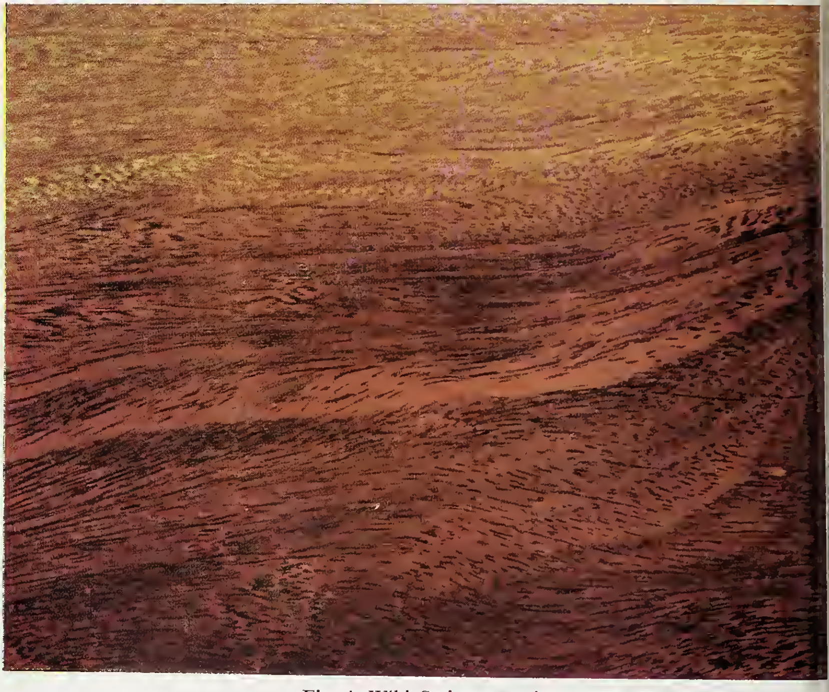

Fig. 4. Wild Seringa wood.

Nigeria and Ethiopia.

Trees usually grow 25 to 30 feet in height and 17 inches in thickness. Logs of more than 15 inches in diameter and 10 feet in length are seldom found. Heart rot is often present.

The logs are reasonably easy to saw into boards, although they are hard and the sawdust is inclined to adhere to the saws. Sand, which appears in hollow logs, also blunts the saw rapidly. One inch boards dry well with a slight tendency to corrugation, but thick planks develop deep centre splits and surface checks. Thick material also dries very slowly.

The sap-wood is not always easily distinguishable from the heart-wood, but usually it is yellow or pink and of a lighter colour than the heart-wood.

The heart-wood varies much in colour from pale to golden yellow through different shades of brown to dark-red with black streaks and markings. Red is the dominant colour. Both sap-wood and heart-wood have a fine lustre. The grain is medium to coarse and strongly interlocked. Successive layers in a board run in directions differing more than 90° from each other; it gives the impression of a wild and tangled grain. Air-dried wood weighs 46 (40-54) lbs., while that from South West Africa is slightly lighter. Both are, however, fairly heavy and fairly strong.

Wild Seringa wood is difficult to plane as a result of the crossed grain, but otherwise it works well.

More sanding than usual is necessary, but a smooth finish is obtained. Sharp edges and profiles are inclined to break away because of the wood's cross-grain, and hence care must be taken to avoid weak tenons. If the necessary care is taken, good mortises can be made and gluing is satisfactory.

The sap-wood of Wild Seringa is attacked by wood-borers, and treatment with a preservative, especially when the wood is to be used for flooring blocks, is essential. Before air-drying, boards containing sap-wood must also be dipped in an insecticide. The heart-wood is durable.

The Wild Seringa makes striking articles of furniture and good hard flooring blocks. The wood is also suitable for sleepers and other outdoor use.

Identification.

The red, golden and black colours, the fine lustre, and the markedly crossed grain are very characteristic. On a smoothly cut transverse plane the vessels and soft tissue usually appear rather close together and in oblique, slightly undulating, lines.

CAMDEBO STINKWOOD

Celtis africana Burm. f.

Standard Name: Camdebo Stinkwood. Also White Stinkwood.

Camdebo Stinkwood is widely known in the Transvaal, Natal, Free State, eastern, north-eastern and southern Cape Province and in Botswana and tropical Africa up to Ethiopia.

The trees are large with spreading crowns, usually 40 feet tall and with trunks of up to 5 ft. in diameter. Large logs of rather good form are obtainable.

The logs are easily sawn in the break-down saw, although there is a slight tendency towards woolliness in sawing. The wood dries without serious defects when the grain is even, but in the case of boards with uneven

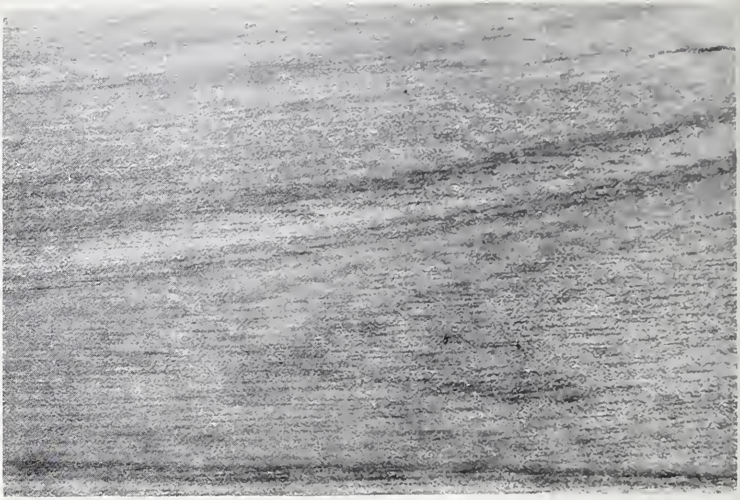

Fig. 5. Camdebo Stinkwood.

grain and abnormal wood because of crooked growth, much warping occurs and stacks have to be provided with more stickers than usual.

The sap-wood and heart-wood do not differ visibly in appearance. The wood is straw-coloured to a light yellowish green colour. Dark irregular markings are often present and give the wood a distinctive appearance. The marking or streaks may be brown or grey and are attributed to incipient decay. The wood is inclined to be ring porous, and this, together with the concentric bands of soft tissue, is responsible for the slight figure. The wood has a medium texture and the grain is generally reasonably straight. The weight averages 47 lbs. per cubic foot air-dried, and the strength is sufficient for furniture and other uses for which the wood is suitable.

Camdebo Stinkwood saws, planes, chisels, sands and turns with ease and glues and polishes very well. It is also an outstanding wood for steam bending.

In the ground Camdebo Stinkwood is not durable and hence treatment with suitable chemicals is necessary if it is to be used for exposed work.

The wood is very useful because of its medium weight and good workability. Furniture made from this wood is very attractive, and it may be used to make beautiful light panels. For purposes such as the building of boats, bent-wood chairs, split spade handles and other commodities made from bent wood it is very suitable. An attractive veneer could probably be made.

Identification.

Ring porousness, which occurs in very few of our indigenous species, is a distinctive feature of Camdebo Stinkwood. The yellowish green colour (freshly sawn) with grey and brown markings, the rays that are conspicuous on all planes, and the arrangement of the vessels in wavy oblique lines in the late-wood portion of the growth ring are good diagnostic features.

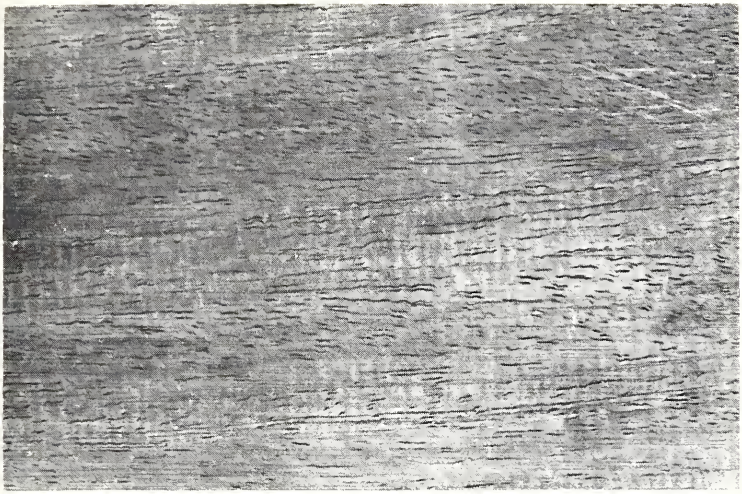

Fig. 6. Tree Fuchsia wood.

TREE FUCHSIA

Schotia brachypetala Sond.

The Tree Fuchsia occurs in a wide strip along the eastern coast from Port Elizabeth to Zululand and also in Swaziland, south-eastern Transvaal, Mozambique and Rhodesia.

The trees are usually 20-40 feet high with an average diameter of 12 inches with a round dense crown. Straight trunks are rare, since the tree starts branching low down, and logs longer than six feet are few and far between. Log diameters seldom exceed 12 inches.

The sawing of logs causes some difficulty as sawdust adheres to the blades and hampers free movement. Inch boards dry very well and become air-dried within thirty days.

The sap-wood is usually broad and appears pink when freshly sawn. Later the colour changes to a light yellowish brown. The heart-wood forming a rather thin central portion of the log is of a markedly green colour with brown and light red markings. In course of time the colour changes to a dark-brown with a green tint. The wood has light streaks caused by concentric bands of soft tissue. The texture is dense and fine but sometimes appears coarse because of the size of vessels and vessel groups that clearly appear as curly short lines on longitudinal surfaces. The grain is usually cross-grained and quarter sawn wood displays a stripe figure. A fine crimp is generally to be seen in the grain.

The wood weighs between 45 and 55 lbs. per cubic foot air-dry, and is heavy, strong and hard; its hardness and toughness cause difficulty in working. Sawing, planing, boring and mortising are difficult, and the grain chips or lifts when quarter sawn surfaces are planed because of the cross-grain. The wood turns well and sands very smoothly.

The sap-wood is not durable and should be treated, but the heart-wood is quite durable against insects, termites and decay.

The Tree Fuchsia may be used for furniture, flooring blocks and decorative work, but its difficult workability and scarcity limit its use to a few articles of furniture or small ornaments turned on a lathe.

Identification.

The green tinge in the dark-brown wood is an outstanding feature. On a clean-cut transverse plane concentric bands of soft tissue may be seen to be spaced very unevenly; this is very characteristic. The rays are closely spaced, clearly visible to the naked eye and form a network with the soft tissue, while the vessels are sparsely distributed, singly or arranged in small groups of two to four.

MARULA

Sclerocarya caffra Sond.
Standard Name: Marula.

The Marula grows in the warm parts of Natal, the Transvaal, Rhodesia, Mozambique, Botswana, the northern area of South West Africa and in tropical Africa as far north as Ethiopia and the Sudan.

In South Africa the Marula is a protected tree and may, therefore, not be cut down without the written consent of the Minister of Forestry.

The tree is big with a spreading rounded crown. and grows to 60 ft. in height and 1-3 ft. in diameter. Logs of reasonable dimensions are obtainable, but as a rule they are short.

The logs are inclined to be woolly in sawing and to clog the teeth of the saw. The boards dry reasonably well, but those from the middle of the log tend to washboard and collapse to some extent. Thin boards must be carefully stacked. The wood discolours very easily and must be dried as quickly as possible; if necessary it must be dipped in a fungicidal mixture after having been sawn.

The broad sap-wood is exceptionally liable to Lyctus beetle attacks and must be dipped in a B.H.C. emulsion before air-drying.

The sap-wood and heart-wood look alike, the colour being white to light red when newly worked, but later it changes to a light reddish brown. The texture is medium to slightly coarse and a clear figure may be seen on flat-sawn planks. The figure is caused by denser and darker wood at the end of the growth ring accompanied by a very narrow soft tissue band. The grain is usually somewhat interlocked in successive growth rings, causing a cross-grained appearance.

The weight is 35 (25-43) lbs. per cubic foot air-dried, and the wood is strong enough to make furniture if carefully selected.

Working of the wood is easy if sharp tools are used. There is a slight sponginess which may cause clamping of blunt chisels when the wood gives way. Mortises may be made satisfactorily, and it glues well, turns well and is easily bored with sharp drills.

Marula is very liable to blue discoloration through fungi and to beetle attacks, and hence special attention should be given to the logging, sawing up and drying of the wood. It will probably be safer to fell marulas in the winter, when temperatures are low for fungal growth and insect activity, but the period between cutting, sawing up and stacking should be as short as possible.

Marula wood may be used for furniture, turning, panels, as a veneer for plywood and laminated products and for class exercises in woodwork.

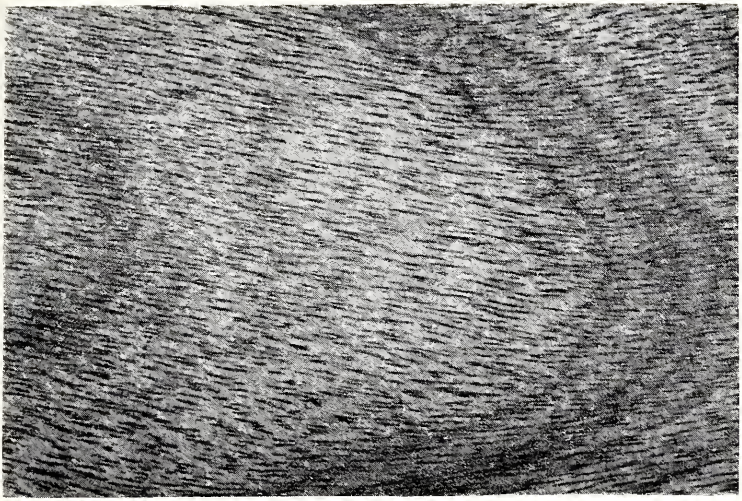

Fig. 7. Marula wood.

Identification.

The light red colour, light weight and rather coarse texture are important qualities. On longitudinal surfaces the vessels always appear as appreciably darker coloured lines against the light ground-tissue. No special feature is visible on the clean-cut transverse plane, except that the vessels are easily visible to the naked eye, are numerous, and appear singly or in radial groups of two to five and in clusters here and there.

MATUMI

Adina microcephala var galpinii (Oliv.) Hiern.

Standard Name: Matumi.

Matumi grows along spruits and rivers in the Low Veld of the eastern Transvaal, Mozambique and Swaziland.

Trees become very large and heights of 60-80 ft. with diameters of four and five feet have been recorded. Long, thick saw-logs may, therefore, be obtained.

Although Matumi is a heavy kind of wood, logs saw easily because of its oiliness and greasiness. The wood does not dry well and considerable loss is experienced through surface checks and warping. Thick boards are the most difficult to dry. The wood around knots and other points of disturbed grain develops most defects.

The sap-wood differs little from the heart-wood in appearance but shows a pink tinge which does not occur in the heart-wood. The latter is yellow to yellowish brown with brown and black marks and streaks. The grain is almost always unevenly wavy or curly and crossed, and the resulting figure is very beautiful. The texture is exceptionally fine and even.

The weight of 58 (50-64) lbs. per cubic foot, air-dried, is considerable, and the wood is strong although the wavy grain weakens sawn wood.

The continuous change in grain direction causes short grain and planing problems. Mortises and tenons may also be fragile as a result of a diagonal grain. The plane is inclined to slip because of the greasiness, but sawing and turning is very easy. However, sand-paper becomes clogged very easily, and the wood does not glue well unless the surfaces are specially treated.

The heart-wood is exceptionally durable and proof against termites and also against ship-worms and other marine borers. It may, therefore, be used for poles, gates, sleepers, quay construction and in other exposed positions. The greasiness also makes the wood suitable for guide blocks in the mines and machine bearings. Although very beautiful, the wood is not actually used for furniture owing to its great weight.

Identification.

The greasy or oily feeling and smell are Matumi's most distinctive characters. The great weight, tawny colour, wavy grain and black and brown streaks furnish further confirmation. On a clean-cut transverse surface the moderately numerous small vessels are only barely visible to the naked eye.

MTSERIE

Bridelia micrantha Baill.

Mtserie grows in the warm parts of eastern and northern Transvaal, Natal and the Transkei, on river-banks and along the edges of indigenous forests. The tree is also found in areas in tropical Africa and Mozambique.

This tree attains an average height of 30-50 feet and a diameter of 10 to 15 inches. Logs of 8 to 10 feet in length and 8 to 14 in. in diameter are obtainable. They are reasonably straight, but basal logs are often strongly fluted.

The sawing of logs may give rise to problems as sawdust is inclined to clog the blades. Boards dry very well with only a slight degree of cupping, end-splitting and formation of small surface checks.

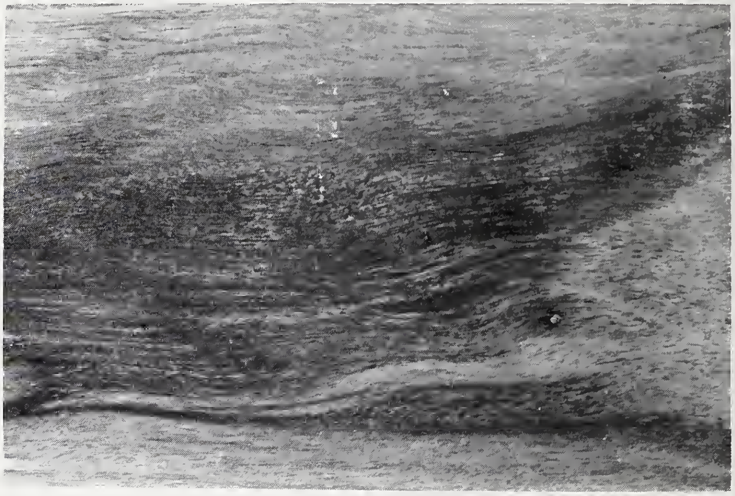

Fig. 8. Matumi wood.

The light coloured sap-wood gradually merges into the brown heartwood that shows a resemblance to stinkwood in texture and colour. The grain is wavy with a beautiful figure that displays considerable lustre. Many small knots are found in the sawn timber.

An air-dried weight of 40 (35-43) lbs. per cubic foot places Mtserie in the furniture wood class.

No problems are experienced with working, except that the grain is inclined to chip around the small knots. Hence more sanding will be required to obtain a smooth surface.

Mtserie heart-wood is reasonably durable, even against termites, and is much in demand for gate and straining posts. The wood is suitable for furniture, has always been favoured for naves and makes good flooring blocks and panels.

Identification.

There is no special character that distinguishes Mtserie, except perhaps the exceptional brown colour, without a trace of red or pink, the presence of numerous small knots, the strong lustre and the medium weight. On a clean-cut transverse plane the vessels, that are reasonably visible to the naked eye, appear in rather long radial groups, are fairly numerous and small and evenly distributed over the growth rings. The latter are difficult to distinguish.

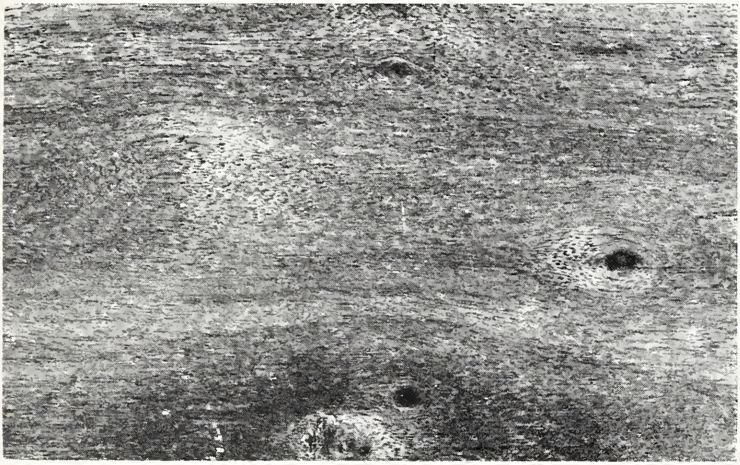

Fig. 9. Mtserie wood.

MOPANE

Colophospermum mopane (Kirk ex Benth.) Kirk ex J. Léonard.

Mopane trees grow in warm dry parts between 1,000 and 2,000 ft. above sea-level in the northern and north-eastern Transvaal, northern South West Africa, Botswana, Rhodesia, Angola, Zambia and Mozambique.

The trees usually have a small crown, an average height of 20-35 ft. and are 6 to 18 in. in diameter. Logs of 8 to 10 ft. long and 6 to 14 in. thick are obtainable. As a rule they have a poor form, contain large knots, and are almost invariably spoilt by heart rot. Because of the hardness of the wood, it is necessary to feed the logs slowly into the machine when they are sawn into boards. The latter dry very well in spite of the wood's density, but sometimes fine though deep surface checks develop in thick planks (over 1½ in.). The defects in the logs result in a low recovery of sawn timber.

The sap-wood is yellow and fairly wide and the heart-wood deep reddish-brown, sometimes with a purple sheen and darker streaks, but mostly without pronounced figure. The texture is fine to very fine.

Mopane is one of the heaviest timbers in South Africa, weighing 76 (73-84) lbs. per cubic foot air-dry and is exceptionally hard, though not as strong in bending as one would expect.

Because of its hardness the wood is difficult to work and slow feed speeds are required when machining. But it does not have an abrasive effect on blades and turns very well. An exceptionally smooth surface is obtained by sanding, and the wood can be polished to a very fine shiny surface.

The heart-wood is almost indestructible in the ground, but the sap-wood is eaten by termites and is not proof against fungi, although it takes fairly long to decay. The sap-wood may, however, be treated with preservatives, in which case full durability may be obtained.

The particular durability of Mopane in the ground makes it very suitable for fence poles. The wood is too hard and heavy for most purposes, and the dimensions of the logs are usually too small for boards and beams of serviceable size. For flooring blocks Mopane is ideal if there is no objection to the very dark colour. For small turned ornaments the wood is eminently suitable.

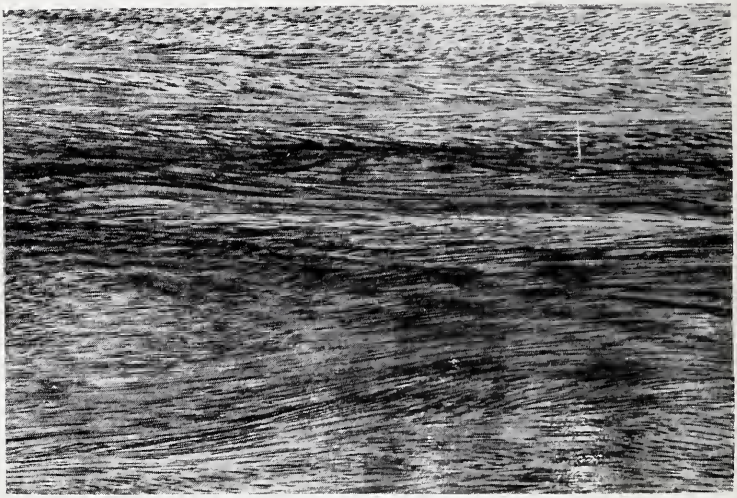

Fig. 10. Mopane wood.

Identification.

The very great weight and the dark reddish-brown colour that has an almost purple sheen are the best diagnostic characters. On a clean-cut transverse plane the vessels themselves cannot be distinguished with the naked eye, but because of the light coloured soft tissue around each vessel, evenly distributed light spots are noticeable. The rays are also difficult to distinguish.

RED IVORY

Phyllogeiton zeyheri (Sond.) Suesseng.

Standard name: Red Ivory.

Red Ivory is a tree which appears sparsely in the bushveld of the Transvaal, in Zululand, Mozambique and Rhodesia. The tree is small to medium in size and logs 7 feet in length and 8-10 in. in diameter are difficult to obtain. The tree's short trunk and its scattered occurrence are responsible for the timber's rarity. When logs of a suitable length are obtained, they are always crooked and difficult to saw.

Except that a slow feed speed must be used owing to the great hardness of the wood, Red Ivory logs may be sawn up into boards without other problems. The boards are very heavy and dense and take exceptionally long to become air-dried. Inch boards take as long as a year to dry properly, especially if one sets about the work carefully in an attempt to avoid surface cracks.

The sap-wood is yellow and the heart-wood a bright pink to bright red, a colour that later changes to orange brown through exposure to light. The texture is very fine and the grain considerably crossed, a fact which is noticed only when one planes the wood. A fine, lustrous, curly grain gives the wood additional charm.

Patience is required in working Red Ivory by hand as well as with the aid of machine tools. Turning is, however, very easy and smooth. The wood saws well and smoothly but is difficult to plane owing to its hardness and the crossed grain. An exceptionally smooth surface may be obtained by sanding, and the wood can be polished to a mirror finish.

The heart-wood of Red Ivory is very durable and almost totally resistant to termites and decay. In this respect it is as durable as Mopane. The sap-wood is not durable.

Red Ivory makes a very good fence post but is much more valuable as a wood for turning and decorative articles such as jewel-boxes, mirror-stands, powder-boxes and other small articles.

Identification.

The bright coral red colour and heavy weight make Red Ivory very easy to identify. Some karee woods and gums are almost equally red, but do not nearly have the same fine texture.

The pore groups can be seen as oblong light-coloured spots on the clean-cut transverse surface. Individual vessels are not visible to the naked eye, but the groups are large enough to be seen. Rays can sometimes be seen and are also very fine.

KNOB-THORN

Acacia nigrescens Oliv.

Standard name: Knoppiesdoring.

The Knob-thorn grows in the eastern and northern Transvaal Low Veld, in Botswana, Rhodesia, Zambia, Malawi, Tanzania and Mozambique.

The trees have exceptionally straight and long trunks and grow to 70 ft. in height and 2 ft. in diameter. Logs 18 in. thick and 8-10 ft. long are obtainable. They are fairly straight but often have a decayed heart.

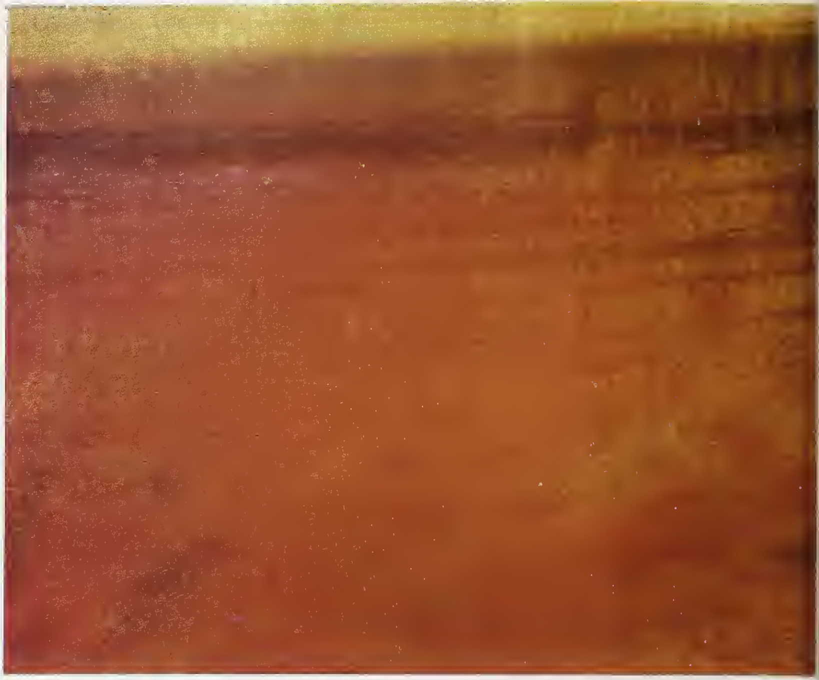

Fig. 11. Red Ivory wood.

The logs must be fed into the log saw very slowly to prevent damage to the saw blades. Sawn boards dry very slowly and develop surface checks which could be avoided to a certain extent by always drying under cover and using thin stickers.

The sap-wood is yellowish white and narrow, and the heart-wood has a very beautiful brown colour with lustrous golden streaks and single darker markings here and there. However, decayed knots and other natural defects in the wood often spoil its appearance. The grain appears coarse because of fairly large vessels, but otherwise the wood is dense and of a fine texture. The direction of the grain is uneven and slightly crossed.

Knob-thorn wood is exceptionally heavy and exceedingly hard; its average weight is 70 lbs. per cubic foot.

Sharp tools and slow feed speeds are necessary to work the wood. The tools very soon become blunt and hence manufacturers are not anxious to work with it. With patience, however, the wood may be dressed with any tools; it also glues well.

The heart-wood is very durable against termites, wood-borer insects and decay, but not the sap-wood. The freshly sawn planks should, therefore, be dipped in a B.H.C. emulsion before drying.

Knob-thorn is too heavy to be used for ordinary furniture, but it is a very beautiful wood, and for those who have no objection to the weight, beautiful suites of furniture can be made. As a flooring block Knob-thorn cannot easily be equalled. But manufacturers are hesitant on account of the extreme hardness of the wood. Beautiful turned ornaments may be made from Knob-thorn.

Identification.

The beautiful brown colour with lighter and darker markings and streaks, the heavy weight and the rather coarse appearance of the grain are the most characteristic features of Knob-thorn wood.

On a cross section the pores are easily seen with the naked eye. They are all surrounded by soft tissue which often links together in tangential bands. There is also a clear tendency towards an oblique arrangement of rows of vessels.

Fig. 12. Knob-thorn wood.

UMVANGHAAS

Albizia versicolor Welw. ex Oliv.

Although the name Umvanghaas has been used for this timber for some considerable time, it is actually a misnomer. Umvanghazi or umvangati are the Swazi and Zulu names for Kiaat. The resemblance (?) between Kiaat and Umvanghaas must have caused the confusion. In Mozambique the tree and the wood are called tanga-tanga.

This species grows in the Low Veld, especially in the north-eastern Transvaal, Mozambique and as far northwards as Central Africa. The trees sometimes become large and a log 11 ft. in length and 28 in. in diameter was obtained for tests. The trees have large spreading crowns.

The logs are usually sound and saw into boards without any problems. The boards dry easily and with few defects, except that surface checks develop in the cross-grained parts. The sap-wood must receive treatment against insects.

The sap-wood appears very white and is usually rather broad, while the heart-wood has a very attractive rich brown colour like that of teak. The heart-wood's colour may also change from light brown to purplish brown and to almost black.

The weight averages 41 lbs. per cubic foot air-dried, and the wood is moderately hard and eminently suitable for furniture. The grain is wavy and also slightly crossed, and the texture is very coarse because of the large vessels and the surrounding soft tissue.

The wood works easily with all tools, but the grain lifts under the plane in places and thus more sanding is necessary. In cross-grained pieces care must be taken to prevent the sides and ends from chipping. Umvanghaas can be glued without difficulty, but the dust caused by sawing and planing tends to irritate one's nostrils causing bouts of sneezing.

Umvanghaas is not durable, but both the sap-wood and the heart-wood can be treated against borers, termites and decay.

It is very suitable for furniture and may also be used for interior trimming, flooring blocks and decorative work.

Identification.

Indigenous timbers of the Republic are usually very heavy, especially the dark coloured varieties. When, therefore, one comes across a brown wood of light weight, it is a good clue to its being Umvanghaas. The coarse wavy lines of large vessels on longitudinal surfaces are another important feature. Although the rays are fine, they nevertheless appear clearly on quarter sawn planes as fine darker flecks or streaks. On the cross section the large pores appear thinly distributed, singly or in short radial groups or clusters. The soft tissue around the vessels has much the same colour as the ground-tissue and is, therefore, not very conspicuous.

FOREST SILVER TREE

Brachylaena discolor DC.

The Forest Silver Tree grows from 35 to 45 feet in height and 12 to

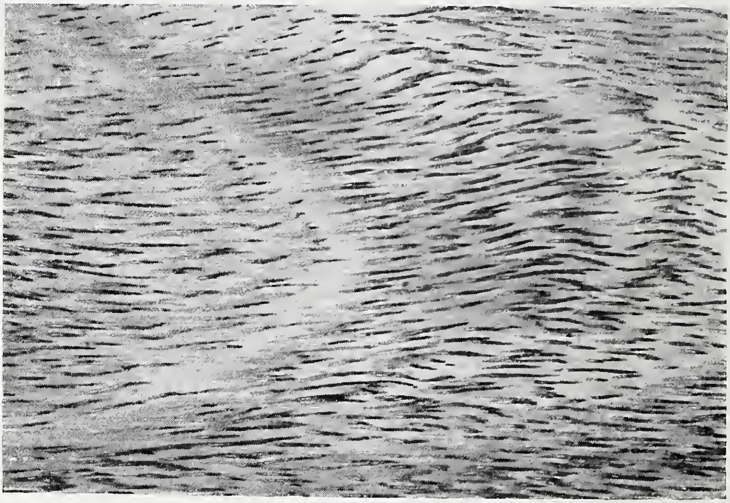

Fig. 13. Umvanghaas wood.

24 inches in diameter. It is found in forests along the coastal strips up to the mountains of the eastern Cape Province, the Transkei, Natal and up to Mozambique. In the Transvaal it appears in the mist-belt forests of the eastern and northern parts and in the Kruger National Park as a small tree or large shrub.

Usually the Forest Silver Tree is a border tree found along the edges of the true high forest.

The logs are not large and lengths of 8-10 ft. and diameters of 12 in. are the best that can be obtained; they are often grooved. However, they readily saw into boards that season well, except those sawn from the grooved parts of the logs in which cracks develop.

The sap-wood is yellowish white and narrow, and the heart-wood light brown with lighter and darker shades in the form of streaks or long markings. The grain is fairly fine and generally straight. The weight averages 51 lbs. per cubic foot and the wood is strong and exceptionally elastic for its weight.

Little is known about the workability of Forest Silver Tree timber, but taking the fine texture and straight grain into account, it may be assumed that the wood works and glues well.

The natural durability has not been tested. Hence the usual precautionary measure of dipping freshly sawn boards in an insecticide must be taken, and pressure treatment with a suitable preservative is recommended if the wood is to be used in contact with the soil.

The Forest Silver Tree's elasticity makes it a popular wood for striking tool handles. The small logs do not yield broad planks for making furniture. The wood's greyish appearance also makes it less attractive for decorative work, although it should turn very well.

Identification.

The wood of the Forest Silver Tree is not very easy to identify. On a clean-cut cross section the hardly visible pores and the soft tissue usually

Fig. 14. Forest Silver Tree wood.

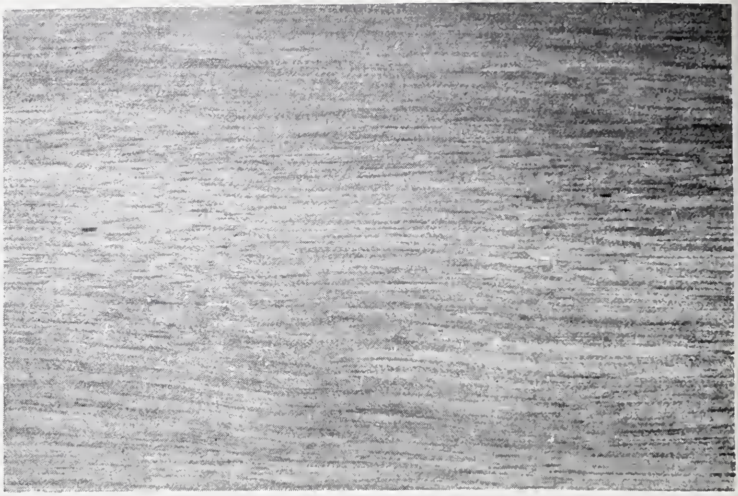

Fig. 15. Natal Mahogany wood.

appear together in finely undulating discontinuous or interlinked bands.

The grooved trunk is often reflected in undulating growth rings. On a planed longitudinal surface fine ripple marks may be seen caused by the horizontal storied arrangement of the rays. It is difficult for the layman to notice the ripple marks unless they are pointed out to him; on the Forest Silver Tree timber they closely resemble finger-prints on the wood's surface.

NATAL MAHOGANY

Trichilia emetica Vahl.

Standard name: Natal Mahogany.

Natal Mahogany grows in Natal, Zululand, Swaziland, the eastern and northern Transvaal, Botswana and tropical Africa as far north as Senegal, the Sudan and southern Arabia.

The trees form large round crowns and usually have short trunks, although long trunks are sometimes found. Logs 6 to 15 ft. in length and with an average thickness of 20 in. are obtainable; but these are usually crooked, grooved or otherwise deformed. Heart rot often occurs. The sapwood is susceptible to insect and fungus attacks, and hence the logs must be quickly converted into boards.

Natal Mahogany logs saw easily and the boards dry exceptionally well whether dried in a kiln or by ordinary air-drying.

The sap-wood and heart-wood look alike, namely white to pink, but eventually tend to become greyish-red to greyish-brown; the latter colour is especially liable to develop when linseed-oil is used.

The texture is slightly coarse and the grain straight, except when crooked logs are sawn, in which case a handsome figure is obtained on the longitudinal planes. The wood weighs 35 (28-42) lbs. per cubic foot, air-dry, and selected pieces will be sufficiently strong for the manufacture of furniture. The bending strength is, however, exceptionally low for a wood of its weight.

Natal Mahogany works easily but is ragged when drilled and slightly corky for mortising. The wood glues and polishes well.

Treatment with suitable preservatives is very important for all uses of Natal Mahogany, and especially logs and freshly sawn planks should be treated with insecticides and fungicides if it is desired to retain the wood's appearance. The wood so easily takes on a blue discoloration as a result of fungus infection that this can be regarded as a character for identification.

Natal Mahogany is a useful, soft and light wood that can be used for many purposes such as shelving, furniture, panelling and picture rails provided that it is protected against wood-borers.

Identification.

The relatively light weight and light red colour, with blue discoloration in nine out of ten cases, are the best diagnostic characters. As a member of the mahogany family the wood has an unmistakable mahogany-like appearance and much resembles okoume or gaboon of tropical West Africa. The rays can be noticed on all planes because they are slightly darker in colour than the ground-tissue.

PIGEON WOOD

Trema orientalis (L.) Blume.

This is a widespread species found from the southern to the eastern Cape Province and through the Transkei, Natal, Zululand, eastern Transvaal and northern Transvaal as far as tropical Africa, preferably in moist mountain forests and mostly as a pioneer in open patches and along the fringes.

The tree usually grows 30-50 ft. in height and 12-24 in. in diameter, and 10 ft. logs with diameters of 10-18 in. are obtained. They are easily

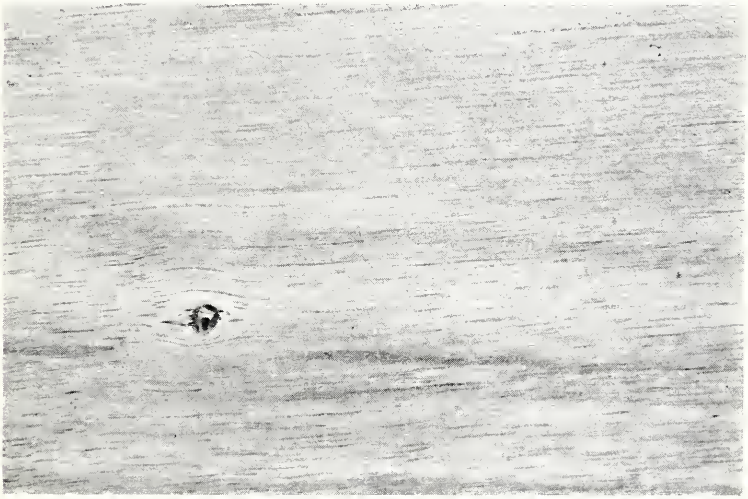

Fig. 16. Pigeon wood.

converted into boards and dry very well. A degree of cupping is sometimes experienced and end-splits develop in a few planks in a load.

The wood is straw-coloured with a pink cast. The sap-wood and heart-wood look alike. The grain is usually very straight but sometimes slightly interlocked. The texture is even and medium to slightly coarse.

The wood works easily but sometimes lifts slightly under the plane as a result of crossed grain. Good mortises can be made and the wood glues well. Sometimes a woolly surface is obtained with sand-paper as the wood is very soft.

Pigeon Wood is a light soft hardwood and may be classified in the willow and poplar group. It weighs 29 (26-34) pounds per cubic foot, air-dried. It is not durable in the ground but may easily be treated with preservatives if necessary.

For purposes where a light, straight-grained, clear wood is required, Pigeon Wood will be very suitable. Shelves, fillers for doors, backs of furniture and similar objects may be made of Pigeon Wood.

Identification.

The exceptionally light weight immediately places Pigeon Wood in a small group of wood species from which it may easily be isolated by studying a clean-cut cross section. The evenly distributed rather large vessels, easily visible to the naked eye, are not arranged very close together and sometimes appear in tangential or oblique lines singly or in radial groups of 2 to 4. The pink tinge that makes it look very much like light saligna is also characteristic. As in the case of Camdebo Stinkwood, to which Pigeon Wood is related, the rays are clearly visible on all planes in most samples.

KAFFIR TREE

Erythrina lysistemon Hutch. and *Erythrina caffra* Thunb.

The Transvaal Kaffir Tree and the Natal Kaffir Tree look very much

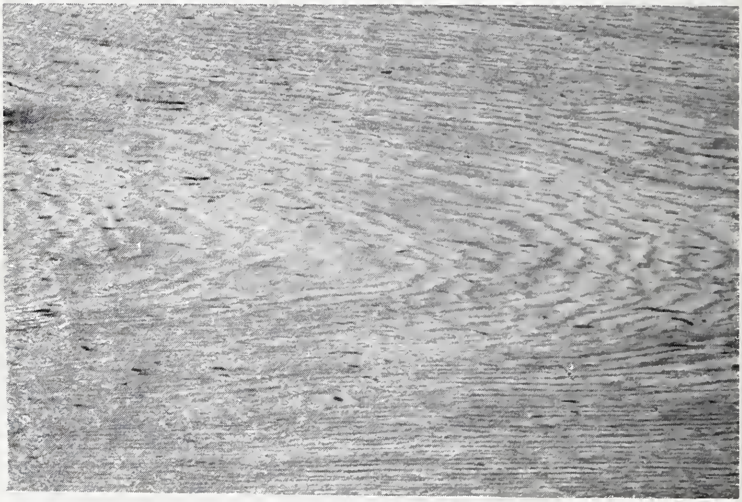

Fig. 17. Kaffir Tree wood.

alike, and it has always been assumed that they belonged to the same species. After careful investigation it was found, however, that the two differ fundamentally, and that even where the two occur together there are no transition types.

Erythrina lysistemon occurs along the eastern coast as far as Zululand and in the warm parts of Swaziland, eastern, central and northern Transvaal.

The tree is usually 10-25 ft. high but sometimes considerably higher, with a trunk of 12 in. and more in diameter.

No record is available of the conversion of logs into boards, but it is assumed that there will be no major problems. The wood contains a very high amount of moisture in the log form and figures of well over 200 per cent, based on its kiln-dried weight, are the rule. Consequently the seasoning process is relatively slow. But the boards dry without many seasoning defects.

The sap-wood and the heart-wood are both white to very light yellowish brown, coarse and straight-grained. The weight averages only 18 pounds per cubic foot air-dried with a range of 15-22 lbs.; hence the wood is soft and mechanically weak.

The very soft surface of the wood makes smooth planing difficult, except with a very sharp plane, and a smooth surface can usually only be obtained by sanding. The wood glues well but mortises and dovetails with difficulty, and will in any event not be used for these purposes. It also saws coarsely.

Kaffir Tree timber is not durable, on the contrary the dried wood is very quickly destroyed by termites. The sap-wood is attacked by borers and must be treated before seasoning.

Although the wood is not durable, it makes good fence posts when planted as large poles that continue to grow and develop into large trees like willow tree poles. As a filler for flush doors and as boxwood the wood is very suitable. There are, however, many other materials available for these purposes, and it is not necessary to fell these spectacular trees for that purpose.

Identification.

The wood is so light and coarse of texture that it can be identified immediately. It could be taken for the wood of a wild fig, but has broader rays and not such broad concentric bands of soft tissue.

FEVER TREE

Anthocleista zambesiaca Bak.

The name "fever tree" is also given to *Acacia xanthophloea* Benth. with the yellow bark.

Anthocleista zambesiaca is an evergreen tree occurring in the lower mist-belt forests of the Transvaal and Swaziland and further northwards. It grows to a height of 70 ft. and a thickness of 2 feet. Logs 10-15 ft. long and 20 inches in diameter are obtainable. They saw easily into boards that dry easily but form deep checks down the middle, especially in boards containing the core. Thick boards and rather thin ones that are cross-grained also develop serious cracks, and there is a tendency towards unequal shrinkage which promotes poor seasoning.

The wood has a light straw yellow colour and medium to slightly coarse texture. The grain is inclined to be considerably interlocked.

The weight averages 35 to 36 pounds per cubic foot air-dried and it

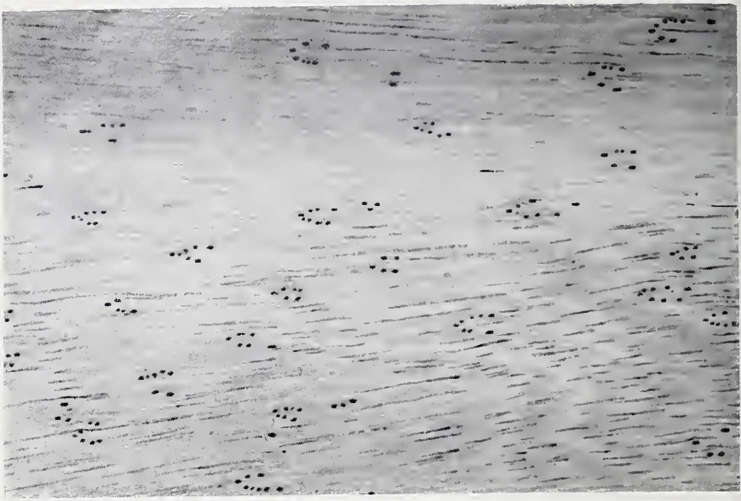

Fig. 18. Fever Tree wood (*Anthocleista zambesiaca*).

is said to be very strong for its weight.

A peculiarity of the wood is the presence of groups of small marks on the flat-sawn surface. They can clearly be seen on the photo and have the form of antelope tracks; their cause is not known.

Except for problems with planing on quarter sawn surfaces, where the interlocked grain causes the wood to chip or lift, there are no other poor working characters.

The wood is not naturally durable and must be treated when necessary.

The wood of *A. zambesiaca* can be used for boxes, shelving boards, the bottoms of drawers, backs of furniture and finishing; in the latter cases it can be painted to cover the extraordinary marks. On the other hand the marks may be emphasized as a special feature by finishing off objects such as panels with a colourless varnish only.

Identification.

As far as is known the marks are always to be seen on boards of this wood and are the easiest identification mark. On a clean-cut transverse surface the evenly spaced undulating bands of soft tissue arranged closely together and sparsely distributed rather large vessels are good diagnostic characters.

TRANSVAAL EBONY

Diospyros mespiliformis Hochst. ex A.DC.

Standard name: Jakkalsbessie.

This is a tree of the Transvaal Low Veld in the eastern and northeastern parts. The Transvaal Ebony is also found in Botswana and South West Africa and is widely distributed over Africa south of the Sahara.

The average size of the tree is 30-50 feet in height and 20-30 inches in diameter. Logs of 6 to 12 feet in length and 10 to 20 inches in diameter are obtainable.

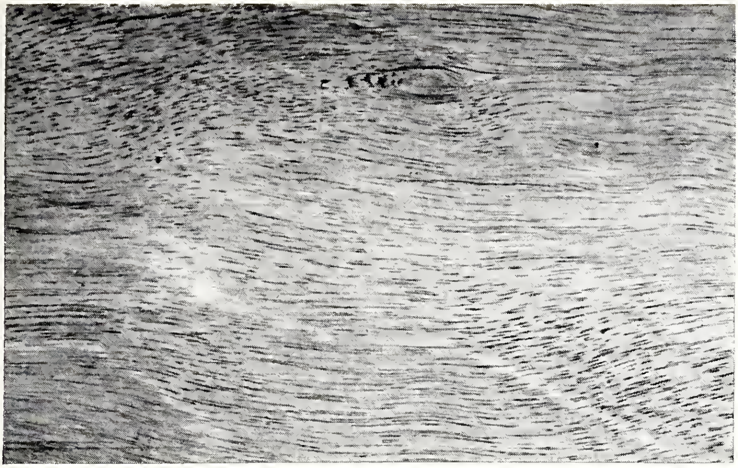

Fig. 19. Transvaal Ebony wood

The logs are easily converted into boards but show defects such as heart rot and decay around the knot-holes and enclosed bark. The boards dry well and only slight surface checks develop. The best results are obtained where the wood is dried under cover.

The wood is pale pink or almost white when freshly sawn but turns a light reddish-brown, often with a blue tinge, after exposure to the light. In some samples peculiar marble-like veins of pink and white are found. The texture is fine and the grain usually interlocked.

The average weight of the wood is 53 lbs. per cubic foot. The bending strength is lower than one would have expected from a wood of this weight, but the hardness is normal. The wood's fine even texture is particularly noticeable, especially when cut with a sharp pocket-knife along or across the grain.

Transvaal Ebony boards saw easily, plane fairly easily, except where the crossed grain causes chipping, are difficult to drill and mortise although this can be done cleanly, turn very well and sand to a very fine surface.

Both heart-wood and the sap-wood are particularly prone to insect attacks against which they must be properly protected, especially during seasoning.

At one time the wood was used for the hubs and rims of wagon wheels. It is suitable for flooring blocks, strip flooring and furniture. Owing to its even texture it should be very suitable for wood-engraving.

Identification.

Transvaal Ebony's light red colour with lighter coloured figuring and fine even texture are its most outstanding characters. Darker red veins are often present. On a clean-cut transverse plane the vessels are just distinguishable and single vessels and radial groups of 2 to 5 can be seen (with sharp eyes!). The rays are almost invisible and concentric bands (growth rings?) of dense vessel-free wood, unevenly spaced, are striking. These bands show up as light streaks on flat and quarter sawn surfaces.

WHITE SERINGA

Kirkia acuminata Oliv.

White Seringa is a tree which is found in the low-lying warm regions of the Transvaal, Rhodesia, Mozambique and as far north as Tanzania. In the Transvaal it is found chiefly in the northernmost third of the province. In South West Africa the White Seringa is also found in the northern parts.

The tree grows to a height of 12 to 60 feet with a trunk of one to two feet in diameter. Logs 7 to 11 feet in length and 11-20 inches in diameter are obtained. They are not very straight and often contain decayed hearts and knots. The heart-wood is usually very small and the sap-wood wide, except in the largest logs.

The logs are easily sawn into boards but have an abrasive effect on the saw's teeth and very soon make them blunt. Under a microscope it is easy to see why the wood has this effect on tools; the ray cells are loaded with silica crystals.

The boards dry well but thick boards take a very long time to season.

The sap-wood is light grey in colour and very broad, and the narrow heart-wood is greenish-brown to brown with dark-brown to black markings of a very attractive curly nature. The ground-tissue has a light yellow-brown colour, and the texture is medium and the grain interlocked and wavy.

The wood is rather light, 37 lbs. per cubic foot on an average when air-dry, and works easily. It saws and planes satisfactorily by hand as well as by machine. Its natural durability is not known, but in the absence of any confirmatory data, it is assumed that it is not durable.

The outstanding appearance of the wood renders it suitable for the manufacture of spectacular furniture and for decorative work. In Zambia the wood was at one time used for making veneer.

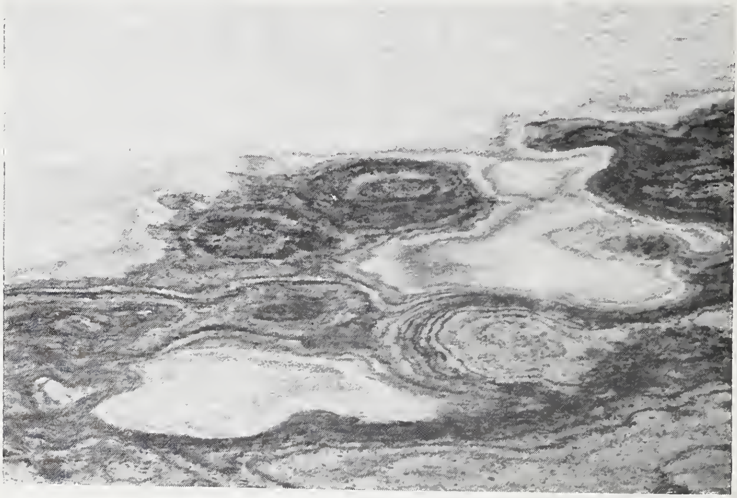

Fig. 20. White Seringa wood.

Identification.

The contrasting curly figure makes White Seringa easily recognisable. On a clean-cut transverse plane the vessels are difficult to see since they are filled with tyloses, but the vessels are reasonably large and numerous. Dark coloured and finely undulating bands which are concentric but vary a great deal in spacing are an outstanding character of the wood. The rays are visible but rather fine and narrow.

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Water-lilies in South Africa

by A. A. Mauve

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WHEN archaeologists examined an ancient tomb in Egypt towards the end of the previous century, the mummies were seen to be covered with wreaths of water-lily flowers. Although about 4,000 years old, the flowers were perfectly preserved enabling Dr. G. A. Schweinfurth, an eminent scientist, to identify them beyond doubt, for they matched the blue-flowered *Nymphaea caerulea* and white *N. lotus* common in Egypt to this day. It showed that the species must be very stable, not having changed in all those years. Water-lilies, the product of the life-giving Nile, were the favourite flowers of the Egyptians and were regularly depicted in their works of art.

The Blue Water-lily (*Nymphaea caerulea*) and the White Water-lily (*N. lotus*) are widespread and common all over Africa, reaching the Transvaal and Natal in their southern migration Presumably the colder climate has halted their invasion of the High Veld.

A third species found in southern Africa is *Nymphaea capensis*. It also bears blue flowers and is the only species found in the Cape Province. Northwards it extends throughout southern Africa as far as Tanzania, Zanzibar and the Malagasy Republic. It is common in the Transvaal, but hitherto no specimen has been recorded from the Orange Free State. What was probably the first description of this plant appeared in 1680, when Jacobus Breynius in his second Prodromus described it as follows: "*Nymphaea flore coerúleo odoratissimo Cap bonae spei; nobis*".

A fourth species, *Nymphaea petersiana*, may occur in the north-eastern parts of the Transvaal. It is very closely related to *N. capensis* and may perhaps prove to be a subspecies of the latter.

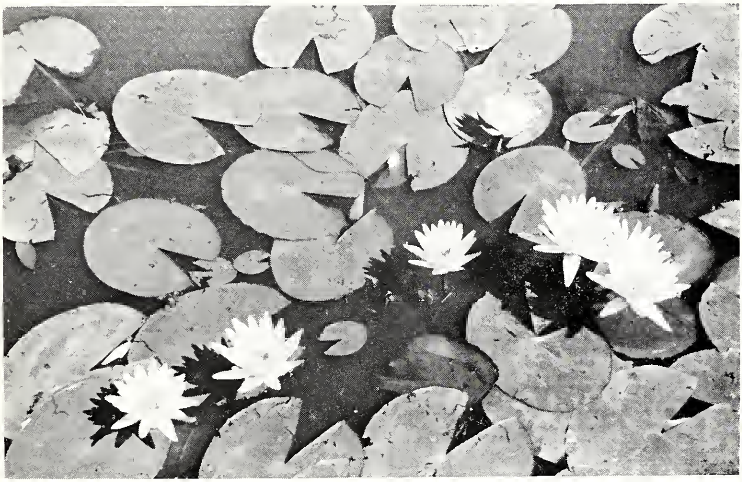

Fig. 1. *Nymphaea caerulea*. Photo: H. J. Schlieben.

Since earliest times water-lilies have been studied by mankind, by the Ancients as well as recent scientists. It proved to be a rewarding study, for the family shows some remarkable features. The base of the plant consists of an erect swollen tuber (that is in the South African species) from which numerous spreading, swollen, spongy roots are given off. Although possessing fine ramifying rootlets, they are devoid of root-hairs. Usually the oldest roots are contractile, that is to say they contract during a dry spell and cause the plant to be pulled down more deeply into the mud. It is thus better protected against desiccation. The tuber, the perennial part of the plant, has a large amount of starch stored inside it for future use. Man all over the world has found a use for it as a food. In Africa women and children of the Bantu tribes go out to collect the tubers when there is an abundant supply and eat them cooked or roasted. The leaves are astringent, bitter and inedible, although some attach medicinal value to them.

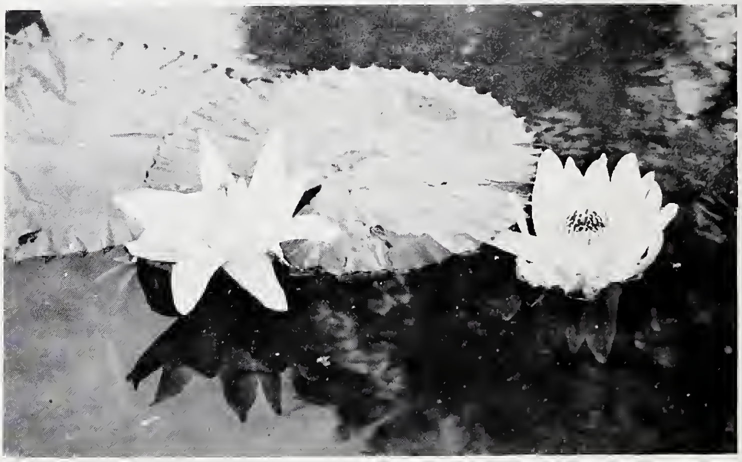

Fig. 2. *Nymphaea lotus*. Photo: H. J. Schlieben.

The long stalks of the leaves and flowers contain numerous air-canals that help to keep them erect and facilitate exchange of gases. Groups of cells containing crystals of calcium oxalate protrude from the walls of the canals. It is thought that these crystals protect the plants against snails and other animals. The leaf-stalks continue to lengthen throughout their short life-span of a few weeks. As a result, the oldest leaves are found furthest away from the plant. This continued lengthening is of importance in case of a sudden rise in the water-level.

The large round leaf-blade constitutes the assimilating organ and as such needs light. It is interesting to observe how well the plant succeeds in placing its leaves in all the available open spaces. The large peltate leaves are not turned over easily, but nevertheless they need placid water. The strongly reticulated nervation, so conspicuous on the lower surface, provides the necessary strengthening of the leaf. The leaves have an unwettable outer skin and transpire a large amount of water from the upper surface, where the breathing pores are situated.

The flowers of our South African species are exserted above the level of the water. Those often seen floating on the water in garden ponds are introduced species, often hybrids with fine flowers in attractive colours. The flowers emerge when ready to bloom and remain above the water for several days. The buds project furthest above the surface of the water, but spiral retracting movements of the flower-stalk cause the flower to recede lower and lower until the old closed flower is just submerged or half submerged, and here the fruit ripens.

The large flower is made up of four large green sepals and numerous delicate colourful petals; inside these there are several rows of stamens. In some species there is a gradual transition from a petal to a stamen, and many also have an appendage above the locules (pollen sacs). The ovary consists of a number of fused carpels that are placed radially inside the hollow base of the flower. The pointed horn-like edges turn inwards and in their midst is the stigmatic area, a concave saucer which in the beginning is filled with a sweetish fluid. The flowers are protogynous, that is to say the stigmas are receptive before the pollen is shed a day later. Conard, the writer of an exhaustive monograph on water-lilies, from which much of my information has been taken, believes that small insects may be the pollinating agents. They enter a young flower in search of pollen and then become trapped or even drown in the stigmatic hollow filled with fluid. When crawling around trying to escape, the pollen clinging to their coats drops into the fluid and will eventually fertilize the ovules. However, it is said that self-pollination is common and parthenogenesis must also occur.

The fruit is a hard round body filled with hundreds of tiny seeds embedded in a loose soft tissue. Conard informs us that the fruit ripens at the bottom of the pool, but this does not happen in the Transvaal. As stated above, they ripen near or just below the surface of the water. Eventually the fruit disintegrates and the freed seeds float on the water for days.

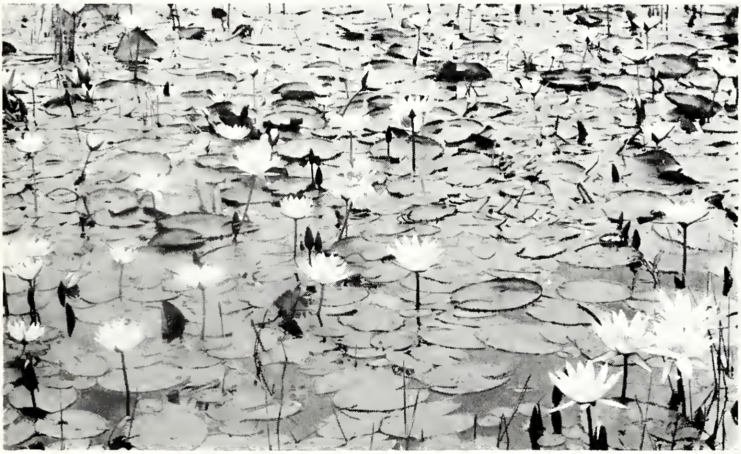

Fig. 3. *Nymphaea capensis*. Photo: H. Lang.

The seeds are covered with a loose, bell-shaped, membranous, white coat (the aril) which, because of trapped air, allows them to float for some time, permitting their dispersal by currents. The hard brown seed is ellipsoid in outline and shows a fine reticulated pattern; it is rich in starch. The seeds are a source of food for man and beast. In West Africa it has been observed that the natives spread the fruits in heaps until the soft parts decay. The seeds are then cleaned and stored. They may be ground into a flour or boiled whole.

Of the three species found in the Transvaal, *Nymphaea lotus* belongs to one section of the genus and *N. capensis* and *N. caerulea* to another.

According to Conard *Nymphaea lotus,* an Old World species, is a nearly odourless night-flowerer. For a few nights in succession the flower opens in the evening and closes again by 11 a.m. the next morning. However, flowers of this species observed in the Transvaal were open during the day. Although bees and other insects were very active in the flowers of *N. caerulea* growing in the same dam as those of *N. lotus,* no insects were seen to visit the flowers of the latter species during the period of observation. The white, cream or initially faintly pink flower is rather coarser than that of the two other blue-flowered species. The broad stamens have no apical appendages. The leaf margin is armed with strong erect teeth but these are only developed later, the margin being smooth in the juvenile stage. There are also differences in the fruit; on the outside it bears green tongue-shaped appendages formed by the persistent calyx and outer filaments; inside the walls separating the seed compartments form a single membrane, not a double one.

Nymphaea capensis and *N. caerulea* both open their flowers during the day from about 8 a.m. to 4 p.m. (depending on the season and age of the flower), for three to four days. The colour of *N. capensis* is usually a dark blue (sometimes pink or a mauvy blue), whereas that of *N. caerulea* is usually light blue with speckles on the sepals but occasionally the speckles are absent. The stamens bear rod-like blue apical appendages.

The two species can be separated by examining the leaf-margin. That of *N. capensis* is sinuate with irregular blunt teeth, whereas in *N. caerulea* the margin is smooth or sometimes shallowly and irregularly wavy at the points where the leaf-margin abuts on the v-shaped incision. When Thunberg described *N. capensis,* he noted that the margin was "*integris*" (whole, entire), but here too this only applies to very young leaves. Apparently *N. capensis* is more common in the Transvaal than either *N. lotus* or *N. caerulea.*

In summer and autumn the well-known Lion Pan in the Kruger National Park is a feast for the eyes, when the plants of *N. capensis* flower there in their hundreds.

Water-lilies are fast growers and gross feeders. In nature their active period is usually limited to six to eight months in the year.

In conclusion, it is interesting to recall that Professor Ichiro Oga of Japan became famous in 1952, when he succeeded in germinating lotus seeds (probably *Nelumbo nucifera,* a member of the same family) 2,000 years old and got the plants to flower. This means that the living protoplasm, although dormant, must have remained alive through all those years.

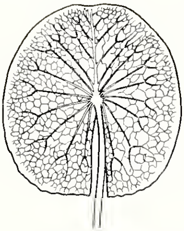

Fig. 4. Leaf of *Nymphaea caerulea.*

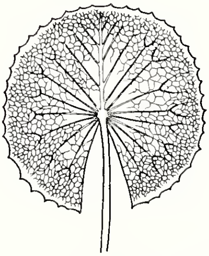

Fig. 5. Leaf of *Nymphaea lotus.*

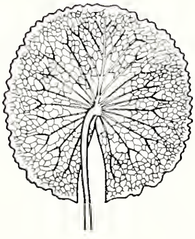

Fig. 6. Leaf of *Nymphaea capensis.*

The Blesbok

THE BLESBOK (*Damaliscus dorcas phillipsi*)
with special Reference to the Herd in the Percy Fyfe Nature Reserve.

W. K. Kettlitz

INTRODUCTION

In the Republic of South Africa the Blesbok has already become part of our farming practice and very seldom presents any problem. For this reason no one has ever deemed it necessary to make a special study of the animal, and it is remarkable how little is actually known of this game species. During the past three years, however, more interest in the life and habits of the Blesbok has been shown by researchers. It is the object of this article to summarize the little information that is available, and to add some remarks on the herd in the Percy Fyfe Nature Reserve.

For valuable data collected by himself and his team of Nature Conservation Officers under difficult circumstances, I wish to express my thanks to Mr. J. G. Willemse, Chief Nature Conservation Officer, Transvaal.

GEOGRAPHICAL DISTRIBUTION

Since the Blesbok has in many instances been mistaken for the Bontebok (*D. dorcas dorcas*) by our pioneers, there is some confusion about the original southern boundary of the Blesbok's range. According to Bryden (1899) it occurred in the Northern Karoo, Orange Free State and the Transvaal High Veld with the Molopo River as its northern boundary.

Nicolls and Eglington (1892) assert that before Sir Charles Warren's expedition in 1884, blesbok were plentiful in Southern Bechuanaland. They did, however, never occur in the present Botswana. The area to which Nicholls and Eglington refer is the present-day Northern Cape.

Farmers have also spread and established the Blesbok outside its original distribution area, so that they now also occur in Natal and almost all the districts of the Transvaal.

A survey by Bigalke and Bateman (1962) by means of questionnaires in the Cape Province accounted for 8,890 blesbok in that Province. Van Ee (1962) estimated that there were 12,000 in the Orange Free State in the same year, while the number in the Transvaal, based on surveys of the Nature Conservation Branch, was 25,000 in 1962. The number in Natal was unknown at that time.

HABITAT AND BEHAVIOUR

The Blesbok grazes on short grass and in its natural distribution area occurs mostly on sour veld or mixed sour veld (Kettlitz, 1962). They are gregarious animals and can live peacefully in large herds on the open grass veld.

Blesbok are exclusively grazers but can hardly survive on long coarse grass. Like most other antelopes, they prefer sweet veld when available, but do very well on sour veld provided that the grass is short. After the growing season, when domestic stock rapidly deteriorates in condition on sour veld, blesbok are still comfortable and in fair condition.

In answer to the question, "Will they collar all the good grazing?" Mr. Hart, a blesbok farmer, replied, "No, they are not at all fussy about their food" (Skead, 1949).

During the winter Col. Weyers, a blesbok farmer near Pretoria, allows his blesbok to graze in the harvested maize lands to supplement their winter grazing, and there they eat the green grass shoots that grow in such cultivated lands. No damage done by blesbok to cultivated crops has been placed on record. They also graze during the night and take mineral licks readily.

When water is accessible, blesbok will drink at least once during the day. Col. Weyers states that his blesbok drink every day between 11 a.m. and 4 p.m. Other herds have other drinking times. Blesbok may go for a week without water when it is not available, but at the end of this time they become restless, stop grazing and soon deteriorate in condition. Not much is actually known about their drinking habits, except that a herd will troop out to the water in small groups to drink either during the day or night.

WEIGHTS AND AGE

A Blesbok weighs approximately 14 lbs. at birth and attains an average weight of approximately 75 lbs. at the age of 8 months.

The weight of mature blesbok varies somewhat depending on the locality and method of exploitation of the herd. The average weight of 26 adult males determined by J. H. M. van Zyl at the S.A. Lombard Nature Reserve was 174 lbs., the heaviest being 197 lbs. This seems to be the approximate average weight of blesbok males in their natural state. The average weight of 38 adult males in the Loskop Dam Nature Reserve was 158 lbs., the heaviest being 183 lbs. Mr. Percy Fyfe told me that selected large males from his herd (before 1953) usually weighed a little

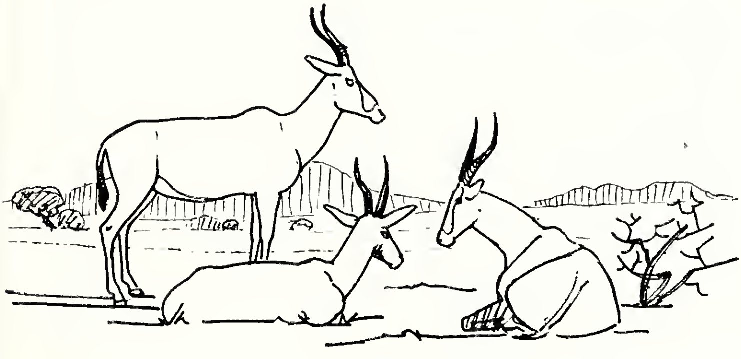

Fig. 1. A group of Blesbok.

more than 190 lbs., and that he never succeeded in shooting a 200-pounder. In the Percy Fyfe Nature Reserve 2½-year-old blesbok averaged 144 lbs. Hence it appears that blesbok may gain another 20-30 lbs. in weight after maturity has been reached. The average weight of the female is 140 lbs.

Without a telescope, blesbok in the veld can only be classified into two groups, viz. lambs of up to one year and older animals. It is not possible to classify a herd of blesbok in various age groups, unless they are handled individually.

The blaze on the Blesbok's forehead is black in the case of lambs, while the rest of the face is light grey and brown. This black blaze slowly starts changing at the age of about one year to a mottled one and eventually turns white, while the rest of the face becomes much darker.

REPRODUCTION AND SEX RATIOS

Herds are composed of animals of all age groups, but males and females form smaller groups during the mating season.

If blesbok are kept in enclosures which are too small, many of the males may be killed during fights because they are unable to escape. This phenomenon has been observed even in camps up to 150 morgen in size.

Little is known about the actual rutting process and behaviour. The opinion has been expressed that males may actually form a territorium, in which a certain number of females are strictly guarded by these males. Colonel A. F. Weyers states that one male separates a number of females from the herd during mating and will attack and chase any other male threatening this harem.

Three samples of about 100 eight-month-old lambs from the herd at the Van Riebeeck Nature Reserve gave the following sex ratio (Sandenbergh, personal communication):

1959	1 ram	:	1.02	ewes
1960	1 „	:	1.38	„
1964	1 „	:	1.03	„

Brand (1963) examined the records of 53 lambs born in the National Zoological Gardens in Pretoria and found the sex ratio to be 1 : 1.12. Lambs of eight months in the Percy Fyfe Nature Reserve consisted of 1 male to 1.08 females. Existing data show that more females than males are born and remain alive up to the age of eight months.

Kenneth (1947) gives an average gestation period of 225 days. Walker (1964) states that the period is between 225 and 300 days, but the latter figure seems to be slightly high. It is generally accepted that the period is 7½ months.

Rutting usually starts in April and continues for two months with the climax during the middle of April, but the period varies in different areas. Usually the ewe gives birth to a single lamb towards the end of November. Occasionally lambs are dropped as late as February. Brand (1963) found the climax of the lambing season to be between the 15th of November and the 15th of December in the Pretoria National Zoo, and that births occurred from the beginning of November until the end of

February. Twins have never been recorded. Albino lambs have been observed, but at an early stage they are already noticeably weaker than the others and apparently die at an early age.

Females are usually sexually mature at 18 months, and it is presumed that males mature later, though males eighteen months old are known to mate.

Both the male and female have horns, but the latter's horns are slightly more slender than those of the male though approximately the same length. The heavier horns of the mature male are usually straw-coloured at the base, whereas the female has dull black horns. Old males in a herd are easily distinguished by means of their heavier build and darker colour. Owing to the similarity in appearance of the full-grown antelopes, even experienced blesbok breeders have difficulty in determining the sex without binoculars. Sex determination in lambs is also difficult. Male lambs usually have thicker, heavier horns, but as this is not necessarily the case, it is advisable to examine each animal individually.

Little is known about the longevity of the Blesbok. Skead (1949) quotes Mr. Hart, a blesbok farmer, as stating that "the original ram was shot 14 years after its arrival, and one ewe lived for 16 years".

GENERAL

Blesbok do not require trees or any other shelter. If kept in paddocks. care must be taken that the enclosures are large enough for their rutting requirements and behaviour. The killing of males (and in many instances even females and lambs) by adult males occurs in small paddocks and is not related to density or overpopulation. Nor is this limiting factor associated with the availability of food.

Blesbok can hardly jump but are known to crawl through fences like domestic goats or sheep. A 4 ft. 6 in. fence with the bottom strand three inches above the ground and strengthened with additional strands to a height of 2 ft. 6 in. is considered to be a very sturdy blesbok fence. Most herds are confined by ordinary six wire 4 ft. stock fences.

When frightened the Blesbok utters a nasal snort, but no rutting sound has been noted. If lambs are caught, their bleat is very similar to that of a kid or a sheep lamb.

During a certain period of the year blesbok constantly nod their heads, which is sometimes attributed to the sinus maggots that affect these animals, but these maggots have no detrimental or other effect on the Blesbok. Zumpt (1965) describes these larvae as obligatory parasites of the Blesbok. There are three species of flies which are responsible for the nasal larvae.

In the veld blesbok are not aggressive. Out of more than a thousand blesbok handled by me, I have never come across a single animal with a threatening attitude. They are easily handled by the horns and kick backwards like an ox if taken by the hind legs

Blesbok are very strong runners and the deep chest is an indication of endurance. When running fast, they lower their heads so that the horns point forward. When pursued they very soon run with open mouths, giving the impression that they are tired, whereas they are actually very far from being exhausted.

As far as we know, the Blesbok has no diseases, but this does not imply that they cannot contract diseases. They are sometimes suspected of infecting domestic stock with "snotsiekte" or nasal catarrh, but there are stock farms on which blesbok have been kept for more than a century without the occurrence of nasal catarrh.

The head-nodding action of the Blesbok associated with the nasal larvae gives the impression that it has a nasal infection, and the averred "snotsiekte" infection may have originated from this phenomenon.

The susceptibility of blesbok to heartwater disease has been proved on experimental animals at Onderstepoort by Neitz (1935 and 1937). By means of the blood of infected sheep and the bites of infected bont ticks the disease was transmitted to the test animals. He states: "Up to the present heartwater has not been demonstrated in antelopes living under natural conditions." Although many blesbok have been introduced into heartwater areas, no cases of heartwater have been recorded.

Owing to the natural distribution of blesbok and the fact that all herds occur on fenced land, this animal has only one predator, the Black-backed jackal (*Canis mesomelas*), to cope with. But this predator is no match for a Blesbok ram or ewe. Lambs are almost under constant protection of the herd, and it is usually only stray or weak animals that fall a prey to the jackal. During the actual birth, or shortly afterwards, it is possible that a jackal may catch a lamb, but little is known about this.

Blesbok and cattle do very well together, and there is not much competition between them since the Blesbok can graze much shorter grass than cattle. In long grass veld the grazing of cattle is also necessary or else blesbok will deteriorate in condition.

ECONOMIC VALUE

The price of blesbok carcasses, like most other species of game, is rising every season, and the demand for blesbok meat remains greater than the supply. During the last decade the price increased gradually from R7 to R14 per carcass. Live blesbok are sold for R14 to R20 per head.

Although blesbok occur only on fenced land, they offer good sport and are not as easy to hunt as may seem to be the case. The hunter must be a good shot, for they become very shy after the first few buck have been shot; ranges of between 300 and 600 yards are normal on large farms. With its deep chest the blesbok is exceptionally tough and needs a good shot to bring it down; it also requires experience to follow up and locate a wounded animal. The most suitable rifles for this species are a .306 with 220 grain bullets or a .270 calibre with 150 grain bullets (Riney & Kettlitz, 1964).

Blesbok hunting is not as popular as the hunting of bushveld types. The blesbok hunter does not have to search for his quarry, because the animals occur on the open veld and he can locate them directly. Hence it is not so challenging a sport.

All venison is tasteful if prepared in the proper way. The flavour of blesbok meat is similar to that of domestic stock, and thus it is very popular in hotels and restaurants.

HYBRIDIZATION

Hybridization between the Blesbok and the Red Hartebeest (*Alcelaphus buselaphus*) does occur. The most notable example is that which occurred on the farm Lion's Glen in the Ermelo district. Two ewes and a ram of these hybrids collected by Adendorff, Kettlitz and White on 26th June, 1956, are in the Transvaal Museum. In this particular case a Red Hartebeest bull mated with a Blesbok ewe. No progeny of these hybrids has been observed, although quite a number of mature hybrids was seen.

Hybrids between the Blesbok and the Bontebok occur, but it has not been established whether these hybrids are fertile.

The mean shoulder height is 38 in. and the length, excluding the tail (which is approximately 10 in.), is about 60 in. The shoulders are about 2 in. higher than the haunches and the horns average about 15 in.

The mean measurements of blesbok in the year 1965 and those of the previous century are the same, and no physical decline has been observed between the present representatives of the species and the "trekbokke" of the previous century.

THE BLESBOK HERD IN THE PERCY FYFE NATURE RESERVE

This provincial reserve is approximately 20 miles north of Potgietersrus in the broken country of the Pietersburg plateau (Fig. 2)

In the thirties the late Mr. Fyfe imported seven blesbok over a period of two years from the Orange Free State, and these formed the nucleus of the present herd. Until 1953 only a few buck were cropped for domestic purposes from the herd kept on approximately 1,000 morgen. Until 1965 the herd was kept together with from 100 to 600 head of cattle for at least a few months in the year, depending on the available grazing.

During the past twelve years this herd has been fairly heavily cropped owing to limited grazing and droughts, and also to satisfy the heavy demand for live blesbok by farmers for restocking purposes.

The process of utilization follows the following pattern:

(a) Captures usually take place at the end of July or the beginning of August of each year, when live blesbok are sold to farmers in the ratio of 1 male to 2 females.

(b) During June of each year surplus males are cropped by shooting one male for every two females that are expected to be sold alive in the ensuing capture.

The time of capture is chosen in such a manner as to ensure that the lambs are large and strong enough to withstand the pressure inside the catching crush. It is not advisable to capture at an earlier date unless other methods are used.

The shooting of males starts after the rutting period and ends about one month before the capture. The procedure in hunting males is to select the largest and thus usually also the oldest animals.

In June, 1965, fifty-five males were shot. At the end of July 293 blesbok were handled alive in the capturing crush, and of these 60 males and 120 females were sold to farmers.

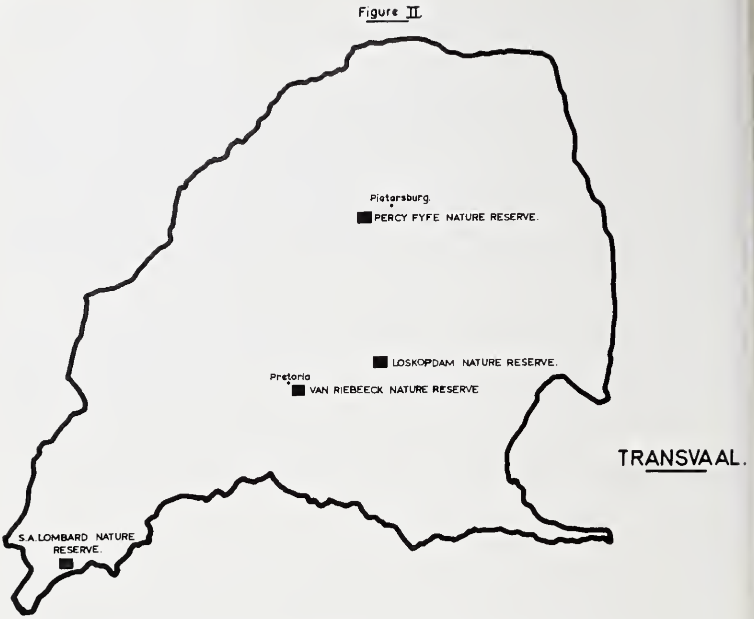
Figure II
Pietersburg.
PERCY FYFE NATURE RESERVE.
LOSKOPDAM NATURE RESERVE.
Pretoria
VAN RIEBEECK NATURE RESERVE
TRANSVAAL.
S.A. LOMBARD NATURE RESERVE.

Fig. 2. Map of the Transvaal Province showing the location of the nature reserves referred to in the text.

THE CAPTURING PROCESS

The reserve is divided into five camps. The blesbok are herded against the prevailing wind, from the most easterly camp until they are eventually all crowded into the most westerly camp. In each camp small groups will normally break away and these are left behind.

The large herd is now driven into a smaller camp, from which it is forced into the actual catching camp. During this process small groups break away from the main herd and are left behind. Because the catching camp can only accommodate about 250 buck, a large part of the herd must be cut off before it enters this camp. In this way approximately 220 blesbok were allowed to enter the catching camp during the first effort in 1965. On the following day groups of approximately 30 buck were cut off into a circular crush from which they were removed by hand.

The 180 buck which were sold were sexed and divided into two age groups, viz. buck of less than 1 year of age and those older than 1 year.

After the sale, approximately 40 buck were left in the catching camp. More buck from the herd were again driven into this camp, which brought the total up to 113. These were caught and classified into five age groups, and certain measurements as well as the weight of each animal were taken, after which they were released in the reserve. A count after the whole operation yielded 231 blesbok. As the herd consisted of 466 buck prior to the hunt and capture of 1965, the 293 blesbok that were caught and handled, together with the 55 males that were hunted, constituted a 75% sample of the herd.

This sample gave the following sex ratios between male and female:

Blesbok of all ages .... 1 : 1.30 (151 : 197)
Lambs up to 8 months old .... 1 : 1.08 (46 : 50)

There is no indication that the mortality between birth and the age of eight months is higher in one sex than the other. It is difficult to assess the randomness of this sample of 113 blesbok (24%) of the herd that was examined because buck which broke away during the drive could have done so owing to:

(a) their good condition (strong fit buck sometimes break through the line of beaters);

(b) their sex (ewes at this period are 3-4 months pregnant and hence can lag behind);

(c) their poor condition (weak animals are left behind by the beaters);

(d) gaps which occur in the beaters' line, through which any animals close to the gap will escape. It is assumed that the sample is a random one.

AGE GROUPS

Owing to the fact that a method of determining the ages of blesbok by means of tooth replacement and wear has not yet been worked out, the animals that were examined were classified into five age groups as follows:

Group I — Animals up to 8 months, the age of which is known by colour and size, and which have not shed their incisors.

Group II — Animals with two permanent incisors.

Group III — Animals with four permanent incisors.

Group IV — Animals with six permanent incisors.

Group V — Animals that have shed all the front teeth, including older buck with worn teeth.

Although the correct ages of the animals cannot be determined by means of this classification, it is nevertheless a practical means of grouping the animals, thereby furnishing an insight into the composition of the heard.

TABLE I

GROUPS IN THE PERCY FYFE BLESBOK HERD

Group	Class	Females	Males	Total
I....................	1 to 8 months	15	19	34
II....................	2 permanent incisors	6	5	11
III....................	4 ,, ,,	26	4	30
IV....................	6 ,, ,,	19	3	22
V....................	All permanent front teeth	11	5	16
		77	36	113

If we assume that these animals represented a random sample, then it should be possible to construct a life table for that particular time.

TABLE II

A FEW DATA FROM A LIFE TABLE CALCULATED ON A 24% SAMPLE OF THE PERCY FYFE BLESBOK HERD BASED ON A COHORT OF 1,000 ANIMALS (JULY 1965)

Age group	Number of deaths per 1,000 in each age group			Mean expectation of further life (in age groups).		
	Females	Males	The herd	Females	Males	The herd
I............	194.80	527.77	300.89	2.56	1.66	2.27
II............	77.94	138.88	97.34	2.06	1.97	2.05
III............	337.66	111.11	265.48	1.23	1.55	1.29
IV............	246.75	83.33	194.69	0.86	1.12	0.92
V............	124.85	138.88	141.59	0.5	0.5	0.5

A life table of the herd (table II) shows the effect of the regular hunt-and-capture method of exploitation. The cropping of the oldest males in the herd is clearly reflected in the "mean length of life" column, where a male in group I has a poor chance to reach old age and can expect to live only a further period of one and a half groups.

If we take into consideration that blesbok can reach the age of 14-16 years (Skead, 1949), then animals from this herd are far from this age. The life expectation of females in group I is considerably higher than that of males, because old females were not exploited to the same degree as males.

Both sexes have a high mortality at the end of the group I period. Whereas most other game species show a marked mortality at an early stage in group I, this does not seem to be the case with this herd. The scarcity of animals in group II, (between 1 and 2 years) has been observed by the writer on different occasions during capturing operations in this

TABLE III

WEIGHTS OF BLESBOK IN THE PERCY FYFE HERD

Numbers	Sex	Group	Weight in pounds	Average weight in pounds
1............	♀	3 months	37	—
1............	♀	4 "	44	—
1............	♀	5 "	50	—
1............	♂	7 "	58	—
12............	♀	I	920	76.66 }
18............	♂	I	1,401	77.8 } 77.23
6............	♀	II	674	112.3 }
5............	♂	II	554	111.0 } 111.6
26............	♀	III	3,225	124 }
4............	♂	III	503	126 } 125
19............	♀	IV	2,442	128.5 }
3............	♂	IV	395	131.6 } 130.0
11............	♀	V	1,391	126.5 }
5............	♂	V	635	127.0 } 126.7
62............	♀	II—V	7,732	124.64 }
17............	♂	II—V	2,087	122.76 } 123.7
113............	♀+ ♂	All groups	12,329	109.1

and also another herd. The scarcity of this group in the herd cannot be accounted for, but it may possibly be due to the present system of camps in sour veld areas. When blesbok shed their first incisors and the remaining milk incisors and premolars are in a worn state, they are faced with poor grazing conditions. Since they can no longer migrate as in the past, they are forced to live on hard, sour, autumn grasses at a stage when they are least equipped for such hardship.

Table III shows that the average weight of males in all groups between II and V is only slightly more than that of females. The exploitation of the heaviest males in the herd accounts for this fact. In natural blesbok herds fully grown males are approximately 20 pounds heavier than females.

The average weight of mature blesbok of the S.A. Lombard herd males which were not cropped for 10 years is 160 pounds. The great difference in weights in the two herds can be accounted for by the fact that in the Percy Fyfe herd mature animals are thinned out annually thereby keeping the herd young.

Old males hardly exist in the Percy Fyfe herd; while all the females in group V, except one, were old with worn teeth, all the males, except one, were animals that had recently shed their last front teeth.

The average weight of mature blesbok of the Loskop Dam herd that were not cropped for at least 10 years is 148 pounds. The lower average weight of Loskop Dam blesbok compared with those of S. A. Lombard blesbok is probably due to climatic and grazing differences. The Loskop Dam Nature Reserve is situated in the "Bankenveld" of the central Transvaal, where grazing is hard and sour, whereas the S. A. Lombard Nature Reserve is in the sweet short grass region of the south-western Transvaal.

The fact that blesbok from group I are very seldom sold to farmers and are not cropped in any other way results in greater representation of this group in the herd, compared with other groups, and thus causes the reduction of the average weight of the whole herd.

Various physical characteristics of the blesbok were noted to ascertain whether any correlation between these features and age or sex exists.

TABLE IV

EAR MEASUREMENTS IN INCHES

Ear Measurements	Groups					
	I		III		V	
	♀	♂	♀	♂	♀	♂
Longest ear	$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{5}{8}$	$6\frac{3}{4}$	$6\frac{1}{8}$
Shortest ear	5	$4\frac{3}{8}$	$5^3/_{16}$	$5\frac{3}{4}$	6	$6\frac{1}{8}$
Average ear length	$5\frac{3}{8}$	$5\frac{5}{8}$	$6^1/_{16}$	$6\frac{1}{4}$	$6\frac{1}{4}$	$6\frac{1}{8}$
Broadest ear	$3\frac{1}{4}$	$2\frac{1}{4}$	$3\frac{3}{4}$	3	$3\frac{3}{4}$	3

No correlation between ear measurements and age could be found. Because the shortest ear in group V is shorter than the longest in group I, this measurement cannot serve as a basis for age or sex determination. In all groups females had the broadest ears. Whether this fact can be attributed to more efficient hearing is not known.

TABLE V
HORN MEASUREMENTS OF BLESBOK IN INCHES

Horn Measurements	Groups					
	I		III		V	
	♀	♂	♀	♂	♀	♂ *
Longest horn	7½	7 1/16	14¼	15¼	13	13½
Shortest horn	5¼	4¾	11⅞	12	11¼	
Widest between tips	5⅛	3¾	11¾	9½	6½	7½
Narrowest between tips	2⅛	1⅞	5⅛	5⅝	5⅛	
Greatest base circumference	5⅛	6⅛	5¾	6¾	5	6⅛
Smallest base circumference	4	4½	4½	6¼	5	

*Only one specimen available.

Blesbok under the age of one year can easily be distinguished. Their horns are short, straight, upright and much smaller than those of older animals. There is little difference in the horn length of mature animals of both sexes. The horn base circumference of mature males exceeds that of females in all cases. The width, circumference or length of the horn is, however, no indication of the age in mature animals. (Table V).

There are signs that the horn rings may to some extent be indicators of age, and this aspect is being investigated.

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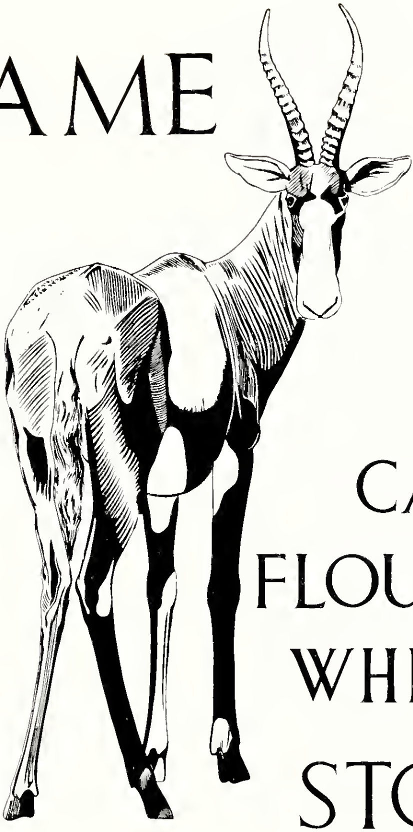
GAME



CAN
FLOURISH
WHERE
STOCK

WILL PERISH

Where the Vultures breed

By F. ZUMPT
South African Institute for Medical Research, Johannesburg

A FASCINATING area for the biologist in the Transvaal is the Magaliesberg Range near Rustenburg, or to pin-point it more precisely, the cliffs on the farm of Mr. E. R. Roberts. During the winter months hundreds of Cape Vultures (*Gyps coprotheres*) breed there on the ledges of precipices, often inaccessible to people who are not experienced climbers. The very keen members of the Witwatersrand Bird Club have encountered great difficulties in reaching the nesting sites of the vultures.

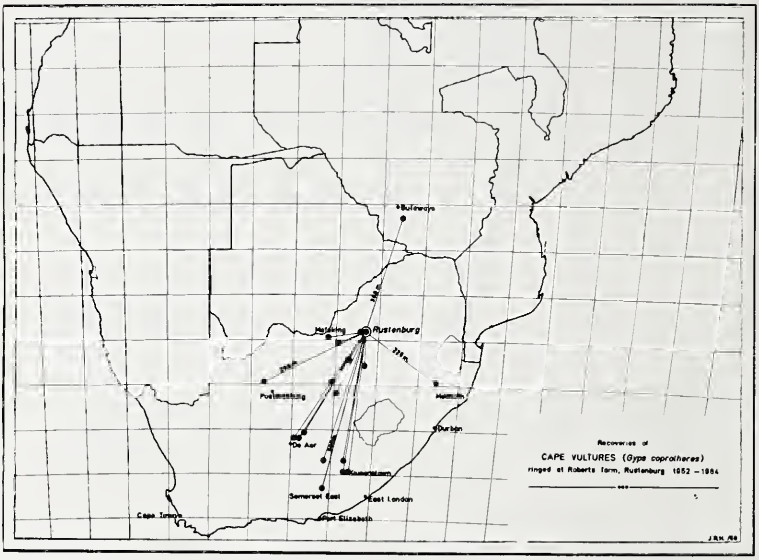


Fig. 1. Map showing recoveries of Cape Vultures (*Gyps coprotheres*) ringed at Roberts's farm, Rustenburg, 1952-1964. Photo: S.A. Inst. for Med. Res.

Every winter since 1952, several excursions to the cliffs on Roberts's farm have been undertaken in order to ring the nestlings, the idea being to find out how far these vultures fly and where they go in search of carcasses. Over a period of 12 years, a fair number of rings from dead vultures has been recovered and sent to the Bird Club. These findings reveal the astonishing fact that the vultures stray from their breeding places for up to 500 miles, and that they fly in all directions, to the north, the west and the east, but most of those breeding near Rustenburg apparently fly to the southern parts of the Republic (Fig. 1).

Such a wide flight-range is not only of academic interest. Is it not possible that these birds suffer from diseases transmissible to man or animals, or that they harbour on their bodies or in their nests parasites

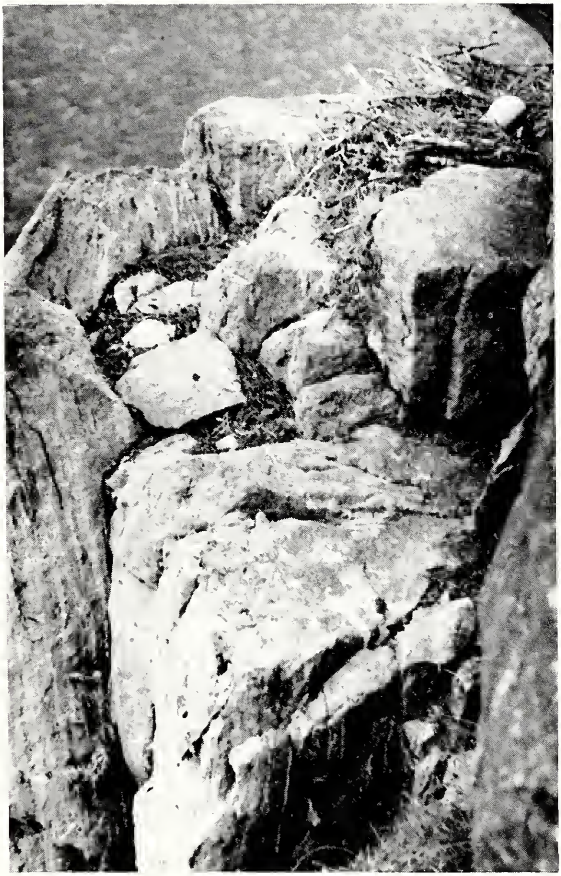


Fig. 2 Nest with egg of the Cape Vulture. Photo: S.A. Inst. for Med. Res.

which are in one way or another harmful to wild and domestic animals, and which they may spread over hundreds of miles?

These were the reasons why I became interested in 1955 in a more detailed investigation of these vultures and their breeding sites. Mr. Roberts promised all possible support and this co-operation was highly appreciated, as was the "alpinistic' help of some of my assistants, both past and present, who climbed up to the nests, collected nestlings and nest material, and examined the rock recesses and cracks on the ledges. These rock climbers are Mr. W. Brauns, Mr. M. Makowski and Mr. K. Ngengebule.

I would like to begin with a few words about the biology of *Gyps coprotheres*. Very, very little is known. Breeding occurs during the winter months. The nest is a large structure of sticks, lined with grass and generally soiled with excrement. Eggs are present from May to July, the clutch consisting of a single egg which is incubated for about 8 weeks. Most nestlings are fully fledged by the end of September.

On the 6th September, 1955, we undertook a trip to the cliffs. Hundreds of vultures were in the air when the nesting sites were reached. Two adults were shot and blood taken from them immediately, and then the

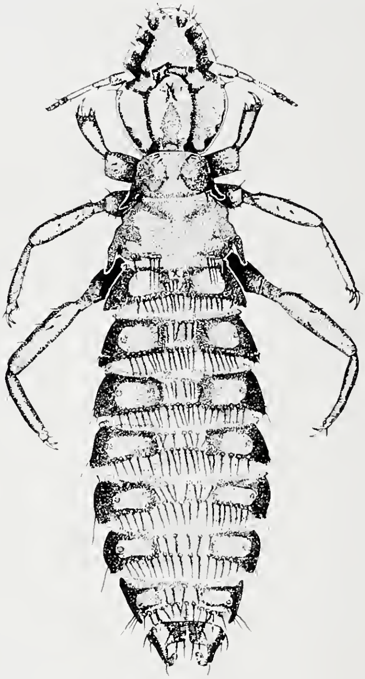


Fig. 3. The biting louse *Falcolipeurus africanus* ♀. Photo: S.A. Inst. for Med. Res.

corpses were placed in bags in order to check them carefully in the Institute's laboratory in Johannesburg. Nesting material was placed in other bags.

The blood samples yielded no results, and there was also no evidence that the vultures were harbouring viral infections.

Highly successful, however, was the examination of the bodies for ectoparasites. Three species of biting lice (Mallophaga) were detected: *Falcolipeurus africanus* Bedford, *Laemobothrion vulturis* (Fabricius), and *Colpocephalum turbinatum* Denny. The first species is so far known only from *Gyps coprotheres* and was described in 1931 by the late Mr. G. A. H. Bedford at Onderstepoort. The two other species have been known for a long time and are found on many other falconiform birds. These biting lice are harmless parasites which feed on the feathers. They have no pathogenic effects.

A great number of mites, measuring up to $\frac{3}{4}$ mm, were found on the dead birds as well as in the nest material. Actually, we had already seen a few specimens of these mites in 1952, when a dead vulture was brought to the Institute, but we had not studied them. Now we were in possession of more material. We found that they were blood-sucking parasites and that they were new to science. Up to the present the only known host of this mite is *Gyps coprotheres*, and the only locality from which it has been recorded is Roberts's farm near Rustenburg. Its scientific designation is *Androlaelaps patersoni* (Zumpt & Till) named after its first collector, Mr. H. E. Paterson, also a former assistant at the Institute.

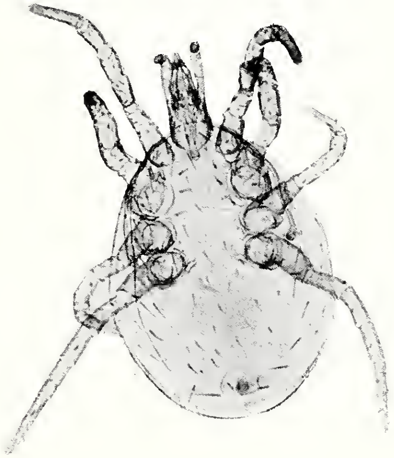


Fig. 4. The mite *Androlaelaps patersoni*. Photo: S.A. Inst. for Med. Res.

The most exciting discovery, however, was a number of tick larvae just over 1 mm long that were found attached to various parts of the body.

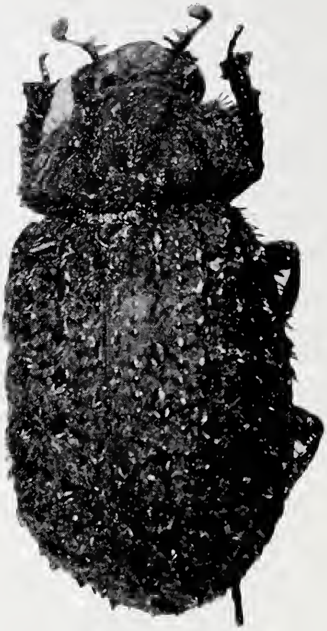


Fig. 5. The beetle *Trox cyrtus*. Photo: S.A. Inst. for Med. Res.

From their general appearance it could be stated that they were related to the so-called Fowl Tampan (*Argas persicus* (Oken)), but they were clearly different and represented a new species. I sent some specimens to the well-known tick expert, Dr. H. Hoogstraal, of the U.S. Naval Medical Unit No. 3, stationed in Cairo. He was very enthusiastic about these findings, confirming that we were dealing with a very interesting new species, but in order to describe it, he urged us to find or to rear the nymphs and adults.

That was easily said, but it took us over 10 years to fulfil his urgent wish.

Since that September in 1955, many more trips have been undertaken to the vulture colony. It was found that the nestlings were also infested with these tick larvae, but where did the nymphs and adults live? We knew from the related Fowl Tampan that two nymphal stages were to be expected, and that they, as well as the males and females, do not attach themselves to the host for a long period (like the larvae), but take a short blood meal and then hide somewhere near the nests or resting places of the adult vultures.

We hoped to find them in the nests and we checked several dozen of them. Interesting nest inhabitants were discovered, some of them being new to science. There was a beetle, *Trox cyrtus* Haaf (Scarabaeidae), that feeds on bones and dry flesh. Its presence in the vulture nests is easily

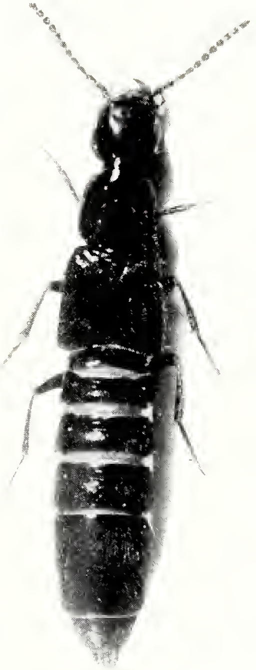


Fig. 6. The rove-beetle *Philonthus sordidioides*. Photo: S.A. Inst. for Med. Res.

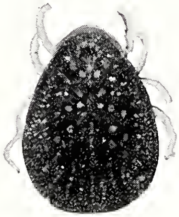


Fig. 7. Adult specimen of the Vulture Tampan. Photo: S.A. Inst. for Med. Res.

explainable. Furthermore, we discovered three species of Staphylinidae, the so-called Rove-Beetle family. One species was known and is quite common, being a scavenger like *Trox*. It is *Staphylinus hottentotus* Nordm. The other two, however, were also new and so far are only known from Roberts's farm: *Philonthus sordidioides* Scheerpeltz and *Atheta gyparionicola* Scheerpeltz. The first is 9 mm long, the other only 3 mm. They are not parasites, but either feed on decomposing nest material or are predators —we do not know which.

A book-louse (Psocida) was also found and identified as *Lepinotus patruelis* Pear (Fam: Atropidae), and two specimens of Pseudoscorpionidea namely *Pselaphochernes natalensis* Beier (a new species), and *Beierius walliskewi* (Ellingson). The Psocid is a scavenger, the Pseudoscorpions predate on them and on other arthropods.

Only in 1966 did Mr. Makowski succeed in finding a badly damaged large *Argas* tick in one of the nests. It was the first adult specimen of the new species. For all of us in the Department this was like the discovery of a forgotten "Rembrandt" somewhere in a flea-market.

The final trip that led to the recovery of a great number of live ticks in all developmental stages took place on the 9th August, 1966, and I quote a part of the relevant report handed to me by Mr. Makowski:

"The final successful trip was undertaken on the 9th August, 1966. The vultures nest on a cliff about 250 feet high, the extent of the colony being scattered for about two miles of cliff. One area is particularly high in vulture density and this yielded the parasites. Seven nests are situated about 90 feet from the ground on a ledge which varies from 1 to 4 feet in

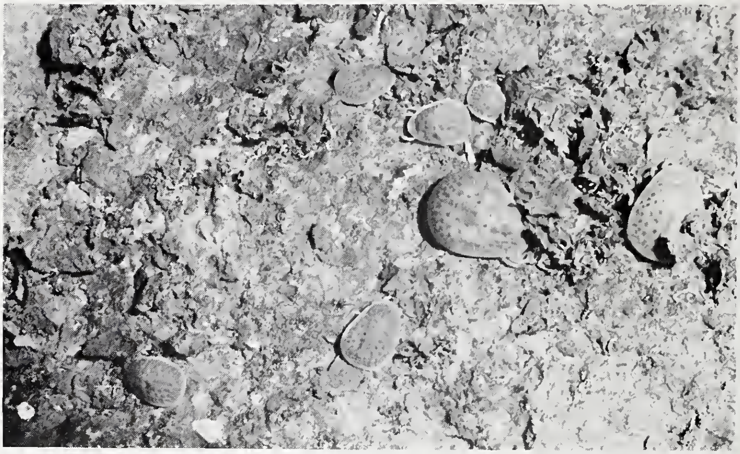


Fig. 8. A number of Vulture Tampans on a rock near a nest. Photo: S.A. Inst. for Med. Res.

depth and approximately 300 feet long. The nests are concentrated in the central portion of this ledge. On this occasion two nests were fully examined, one containing a very young fledging and the other an egg.

"The first nest was situated in a rock recess, on a ledge about 2½ feet above the level of the broad ledge, covering an area of 4 square feet. A crack ¼ inch wide, 2 feet long and approximately 6 inches deep, located about 1½ feet above the nest, yielded about twenty *Argas* adults. They were located in small batches of two to five specimens, in various degrees of engorgement. As a rule the more shallowly placed ones were the most engorged. They exhibited no motion unless disturbed. A large number of ticks was found situated behind a loose flake of rock about 4 feet above the level of the nest. No ticks were found higher than 6 feet above the nest. All the cracks harbouring the ticks were dry and comparatively devoid of debris. No ticks were found below the nest, although there were several cracks. These, however, tended to be damp and dirty, contaminated by vulture excreta and scraps of regurgitated food. The soil around and under the nest was examined and yielded no ticks, being quite damp."

Live material was sent immediately to Dr. Hoogstraal, and he will describe this new species in the near future. Hence the scientific name cannot be disclosed at this stage.

For us more research work lies ahead in respect of the medical importance of the tick and its distribution. Hitherto no disease agents have been isolated from the Vulture Tampans—and we hope that none are found in the future.

This tick has only been found on Roberts's farm, but its area of distribution should be much larger. The larvae are attached at least for several days to the vultures which can carry them for hundreds of miles to the north and south. According to the ringing results (Fig. 1), it is a distance of nearly 900 miles. The engorged larvae can drop from the hosts wherever they settle for feeding or resting. These larvae will moult and yield nymphs which can starve for many months or even years. Will they all die if they do not find a vulture, or can they feed on other birds or even mammals? That is still an unsolved problem.

No one had ever found this tick before—in spite of the fact that a thorough tick survey has been conducted in southern Africa and also in other parts of the continent during the last decades.

The Dolomite Eyes or Fountains of the Wonderfontein Valley in Western Transvaal

W.P. de Kock

INTRODUCTION:

Dolomite eyes are found over a wide area in the Transvaal, but this article of a popular scientific nature is limited to the Wonderfontein Valley situated between Randfontein and Potchefstroom, an area that is better known to me than others of its kind.

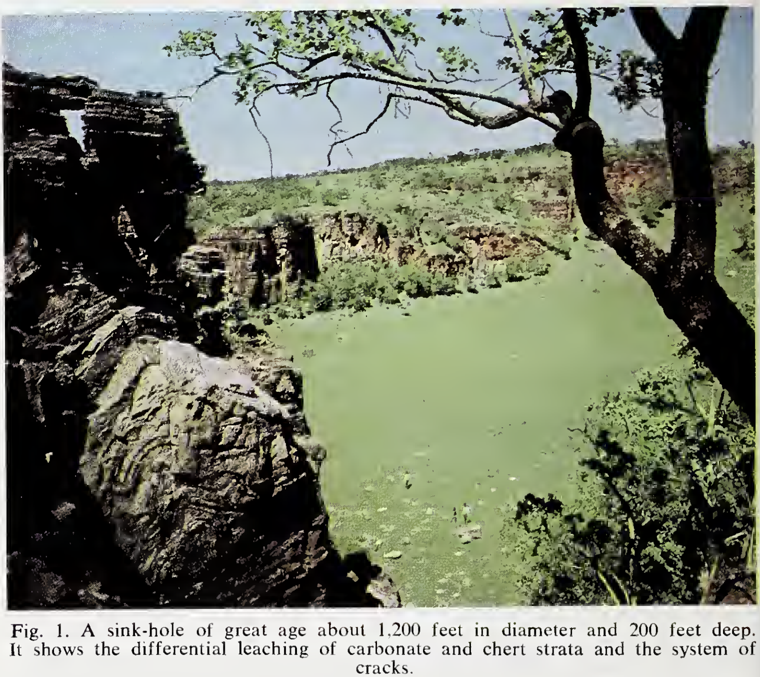


Fig. 1. A sink-hole of great age about 1,200 feet in diameter and 200 feet deep. It shows the differential leaching of carbonate and chert strata and the system of cracks.

Photo: G. Cassel.

The eyes or fountains in the dolomite formation of Southern Africa are well known. Some are the sources of familiar rivers; thus the Kuruman eye is the source of the Kuruman River, the upper and lower eyes (Gerhardminnebron) the source of the Mooi River, and the well-known Magalies River is fed by Malonie's eye. The Fountains at Pretoria are the source of the Apies River.

In an area where there is a lack of running water and that is subject to periodic droughts, it is obvious that the occurrence of permanent fountains with substantial quantities of water is important for human use, for irrigation and the production of agricultural and fodder crops. In these respects they not only make an important contribution to a stabilized economy and to beautifying the landscape, but are also of real importance to nature conservation.

HISTORICAL BACKGROUND

The dolomite eyes of the Wonderfontein Valley were well known to the earliest indigenous races of South Africa, as is clear from the rich finds of stone implements in the vicinity of various fountains. They were probably also known to hunters and other adventurers, who travelled through the area before the Voortrekkers, since they must have been places where game concentrated in large herds, particularly in winter. Farms with names like Leeuwpoort, Elandsfontein, Wildfontein and Buffelsdoorn afford proof of this. As the Trekkers moved northwards from Potchefstroom, this became a favourite route, and there is ample evidence to show that in the early forties of the previous century the Trekkers lived temporarily at places along the Wonderfontein Valley.

The earliest known description of the area is from the pen of the Rev. T. F. Burgers, who later became president of the Transvaal. It was written after his journey in 1871, nearly a century ago. He gives descriptions of the village of Potchefstroom, the Wonderfontein Valley, the caves, the sink-holes and the eyes, especially that of Gerhardminnebron. His account of the latter is so realistic that it is quoted here in translated form: "And whence does the perennial stream (Mooi River) come? We did not have the opportunity to go to the Mooi River's 'upper eye', and hence had to be satisfied with seeing the nearest fountain (Gerhardminnebron). After a ride of fifteen miles, we came to a small ridge on the river's left bank. A few steps took us to a cavity at a spot in the ridge, and there we stood enraptured. Beneath our feet a strong stream flowed out of the side of the rock. The water bubbled out of a horizontal fissure, flowed over some boulders and disappeared speedily in the reeds as if it were shy of the intruder . . ."

Similar descriptions are applicable to all the eyes in the Wonderfontein Valley. They are not really spectacular, since in most cases the water appears between shrubs and reeds and is dammed up in the dense vlei of reeds or bulrushes on the lower side of the eye. Hence it is easy to understand why the fountains are so often referred to as "wonder fountains".

GENERAL GEOLOGY OF THE AREA

The Wonderfontein Valley, in which the eyes occur, is underlain for the main part by dolomitic rocks, a mixture of calcium and magnesium carbonate, belonging to the Dolomite Series of the Transvaal System that attains a maximum thickness of 4,000 feet in this area. On the southern side the dolomite is overlain by layers of shale, quartzite and interbedded diabase sheets of the Pretoria Series, of which the high West Wits Hills are composed that form the southern boundary of the hydrological basin and trend about six miles south of the Wonderfonteinspruit and parallel to it. On the northern side the dolomite cuts out against the underlying Black Reef Series and the basal granite, and this ridge runs about 6-8 miles north of the Wonderfonteinspruit and parallel to it. To the east, towards Randfontein

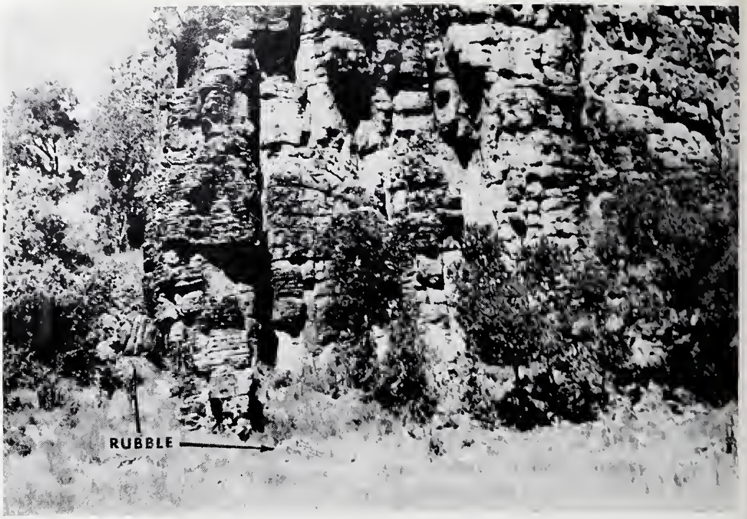


Fig. 2. A close-up photo of dolomite showing the differential leaching of the various strata and systems of cracks.

Photo: F. C. M. Bawden.

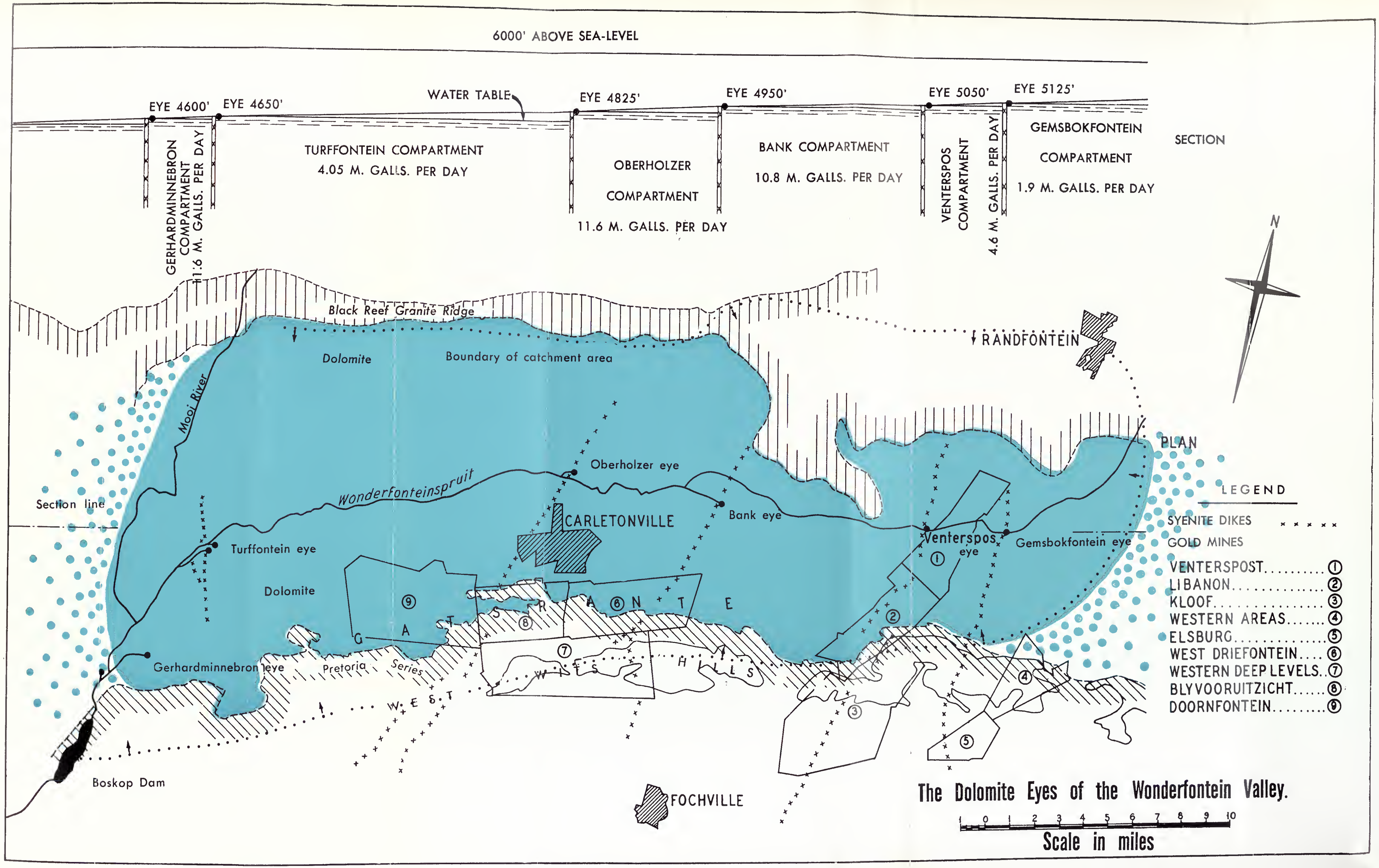
and Luipaardsvlei, where the Wonderfonteinspruit arises, the Transvaal rocks disappear against the much older strata of the Witwatersrand System (see the diagram).

The rocks of the Wonderfontein Valley dip to the south at an angle of about five degrees, forming the southern limb of a regional anticline, the northern limb of which dips northwards underneath the younger rocks of the Bushveld Complex.

In the Bushveld Complex there occurs the nearly circular Pilanesberg, representing one of the largest volcanic complexes in Africa and younger than the Bushveld Complex or the Transvaal System. A whole series of igneous dikes of the syenite type radiate from this younger eruption, almost like the spokes of a wheel. Some of these extend more than a hundred miles from Pilanesberg. A number of the syenite dikes, varying from twenty to two hundred feet in width, cut through all the rocks of the Wonderfontein Valley almost vertically, and as they are impervious to water, they divide the valley into a number of compartments each with its own water table and forming a closed water unit or aquifer, with its lowest point in the Wonderfonteinspruit. It is at the lowest points of the separate compartments, where the water table of each compartment reaches the surface, that the eyes occur (see the diagram). More will be said of this later.

MORPHOLOGY AND HYDROGRAPHY

The West Wits Hills attain a height of 5,750 feet above sea-level, whereas the northern ridge, the Black Reef granite ridge, seldom exceeds 5,400 feet. The hydrological basin of the Wonderfontein Valley extends over an area of approximately 500 square miles with a western gradient varying from 5,250 feet east of Venterspos to 4,600 feet at the Mooi River, a



The Dolomite Eyes of the Wonderfontein Valley.

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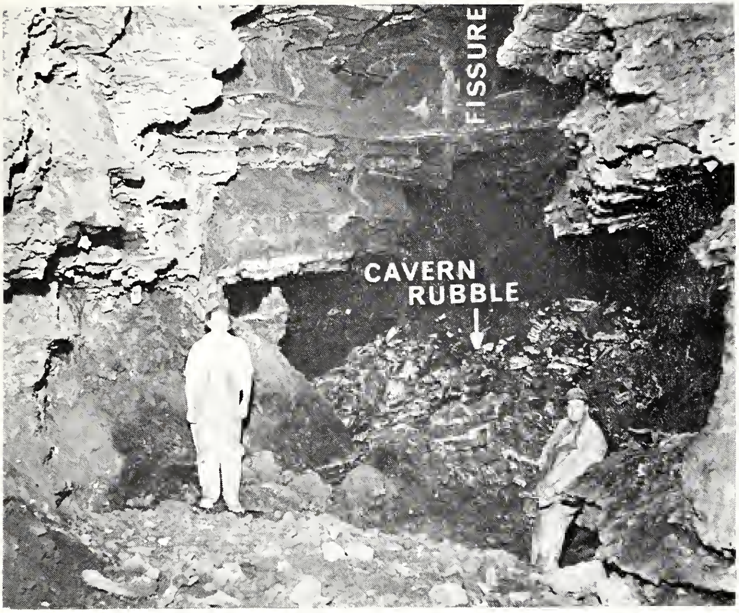

Fig. 3. A subterranean cave showing the leaching of the dolomite in the vicinity of a vertical crack.

Photo: Studio Vader.

distance of about 40 miles. This represents a gradient of 1 in 300. The gradient from the West Wits Hills in the south towards Wonderfonteinspruit varies from 1 in 10 in the steep hills to 1 in 800 in the level plain, with an average of 1 in 50. The gradient southwards from the Black Reef granite ridge in the north to the Wonderfonteinspruit is about 1 in 100. It is obvious from these data that the run-off of water falling in this basin varies from very rapid to slow, and that the intake of water may be reasonably high, particularly where the surface is covered with loose soil and gravel as is often the case where dolomite has weathered to some depth.

It has been estimated that about ten per cent of the average annual rainfall of 26 inches seeps into the upper layer eventually reaching the subsurface water table. This suffices to account for all the water that reaches the surface through the various eyes. Hence there can be no question about the water being juvenile, that is derived from the earth's interior, nor of subterranean rivers connected with areas far beyond the immediate surroundings, as is maintained and believed by some uninformed persons.

Another interesting fact is that bore-holes and shafts have shown that the water-level in each compartment remains very constant; in every instance it is determined by the elevation of the lowest point of the syenite dikes or barriers in the Wonderfonteinspruit marking the outflow or overflow of each compartment. Hence it is clear that the water-level in the various compartments does not sink slowly but by stages from east to west as indicated by the following table. See the section on the diagram.

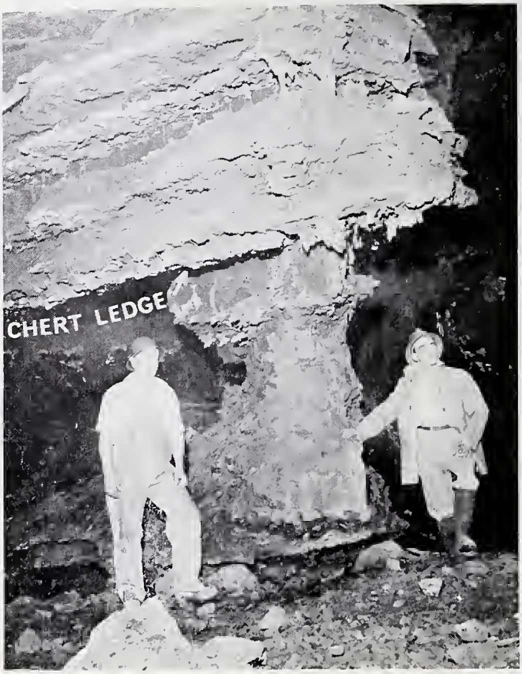

Fig. 4. A cave 400 feet below the surface and just above the water table.
Photo: Studio Vader.

Eye	Height above sea-level	Outflow per day in million gallons
Gemsbokfontein	5,125	1.9
*Venterspos	5,050	4.6
Bank	4,950	10.8
*Oberholzer	4,825	11.9
Turffontein	4,650	4.05
Gerhardminnebron	4,600	11.6

Fig. 5. An irrigation canal with water from the Bank Eye.
Photo: F. C. M. Bawden.

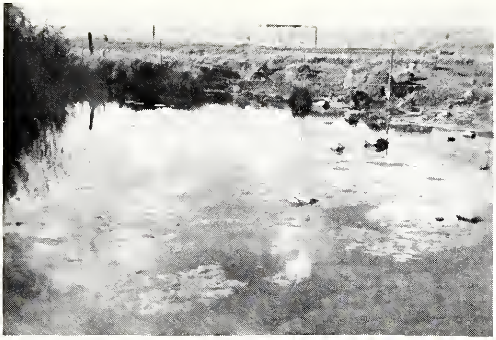

Fig. 6. The Oberholzer Eye. Water bubbles up through the sand.
Photo: F. C. M. Bawden.

* At present these two eyes are dry due to the fact that the water-level in the relevant compartments has been greatly lowered by the quantities of water pumped out by the mining companies in order to carry on underground mining operations.

The figures also show that the quantities of water issuing daily from the various eyes are very high, and as the yields have remained constant during many years — perhaps even centuries — it will be realised what contribution these fountains have made towards the development of agriculture, the scenery and the attractiveness of the area. We shall return to this later.

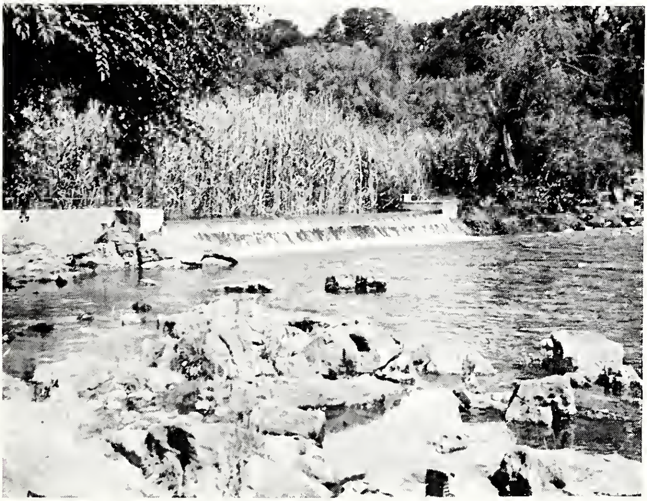

Fig. 7. A beautiful scene about fifty yards below the Gerhardminnebron eye.
Photo: F. C. M. Bawden.

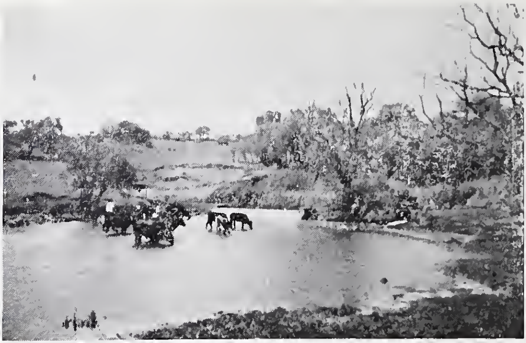

Fig. 8. Below the Gerhardminnebron eye large herds of cattle come to drink from as far afield as seven miles.

Photo: F. C. M. Bawden.

DOLOMITE AS A WATER CONSERVER

Dolomite is for the most part a massive, compact and crystalline rock with practically no pores for storing water like sandstone and similar rocks. Nevertheless it is a well-known fact that carbonate rocks are among the best water-storing rocks of the world. The reason is to be found in their chemical composition and that of the water penetrating them. Dolomite generally has bedding-planes and often also a network of vertical as well as systems of transverse cracks. In cases in which the rocks are tilted regionally, as for example on the anticlinal axis north of the Wonderfontein Valley, these systems become accentuated. Rain-water that percolates

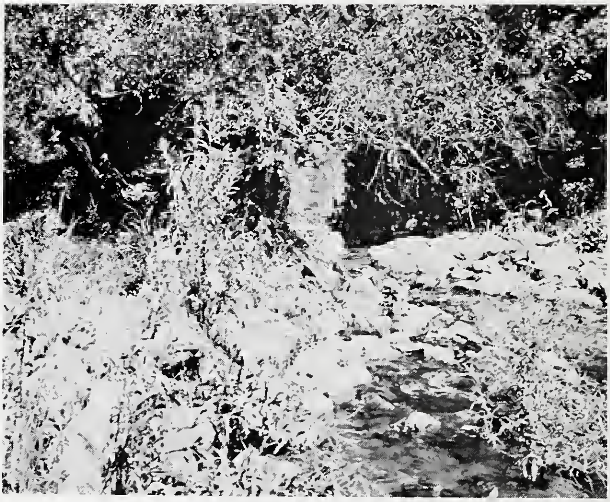

Fig. 9. The lowest eye of the Mooi River, where the water bubbles out between loose stones and a rocky ledge.

Photo: F. C. M. Bawden.

through the surface layer finds its way into the cracks, fissures and bedding-planes of the dolomite and enlarges them by a process of chemical leaching. This process is accelerated in consequence of the fact that water on its way from the clouds to the dolomite absorbs small amounts of carbon dioxide from the air and the surface of the soil, and also small quantities of humic acid derived from decomposing vegetation. Since limestone is soluble in both these acids, they help to enlarge the fissures, cracks and bedding-planes. The leaching process takes place more rapidly where there are fractured zones in the earth's crust or faults than in rocks of a more dense nature, since water penetrates quicker and deeper at such places. This process has been going on for millions of years — and in the case under consideration perhaps hundred of millions of years — and has resulted in the appearance of large crevasses, holes and even caves in the dolomite. (See the photos). From the nature of this process, it follows that the rate of leaching below the water-level is slower than above, and that it will decrease rapidly with the depth underneath the water-level for the simple reason that the available acids will soon be neutralized by alkaline and stagnant water. These statements have been irrefutably substantiated by means of the large number of bore-holes and shafts that have been sunk during the past thirty-five years throughout the length and breadth of the Wonderfontein Valley. It has also been proved that where dolomite is overlain by a reasonably thick layer of shale or quartzite, as in the case of the Pretoria Series, little if any leaching takes place.

Analyses of the water flowing out of the eyes show that it contains about 0.9 tons of dissolved limestone per million gallons; this means that the total amount of limestone that is daily removed in solution from the Wonderfontein Valley amounts to more than forty tons. The result is that the storage capacity of the dolomite is gradually being increased not decreased.

STORAGE CAPACITY OF THE DOLOMITE

This factor is difficult to determine because of the irregular nature, varying size and widely anastomosed branches of the leached passages, fissures and cracks in the dolomite. Nevertheless careful surveys and studies made in bore-holes and shafts in addition to other observations have thrown light on this problem. Reasonably accurate determinations of the drop of the water-level in certain compartments coupled with the figures of the quantities of water that are removed by pumping and the concomitant inflow support the data that follow. An approximate estimate is as follows:—

For the first one hundred feet below the normal water-level the dolomite can store as much as ten per cent of its own volume of water. For the next one hundred feet the figure is two per cent of its own volume. Below two hundred feet water in appreciable quantities is stored only in a few cracks and fissures. Although some of the fissures penetrate to a depth of a few thousand feet, and an occasional one reaches the older strata, their volume is very small in relation to the rocks in which they occur and probably does not represent more than 0.1% of the surrounding mass of rocks.

Hence it is clear that the greatest amount of water is stored directly below the water table and that storage decreases rapidly with depth. That huge quantities of water are stored in the dolomite emerges from the fact that on the basis of the figures cited above the Oberholzer compartment — one of the smallest in the area — contained 150,000,000,000 gallons before pumping by the mining companies commenced.

Since this colossal amount of water is connected with the underground workings by means of vertical fissures, especially along post-Transvaal faults, it is obviously a real danger to the mines. It has also been established that if water that is pumped out is allowed to run over the surface of the same compartment, it finds its way back to the dolomite and finally into the stopes. This has been definitely proved by means of salt and flourescein, and subsequently by using potassium iodide isotopes. This process of re-circulation resulted in the same water being repeatedly pumped with very serious economic implications. Lowering of the water-level and the effective removal of the water from the relevant compartments, or in other words purposeful dewatering, resulted in an appreciable improvement of the position.

ORIGIN OF THE EYES

The geological background of the territory in which the "wonder fountains" arose has been sketched. It is now necessary to discuss the physical features in greater detail and to explain why the water is forced to the surface.

When rain falls in the area during the summer, some of the water percolates through the upper layers and reaches the surface of the dolomite; it sinks down along the channels already mentioned until it reaches the water table. This process is supplemented by storm water that runs down from the surrounding Pretoria, Witwatersrand, Black Reef and granite rocks to the dolomite in the valley. In the environs of Wonderfonteinspruit, where the rocks have been leached to a greater depth, and where the storm water is checked by reeds, bulrushes and other vegetation, some of this water finds its way to the natural water table, with the result that there is a local build-up of the level beyond its normal height; the latter is the point at which the water runs over the syenite barrier in the bed of the Wonderfonteinspruit. At this point the water runs over the barrier and gives rise to the eye or fountain. Although the yield of different eyes often shows an appreciable seasonal variation, particularly in very dry years, a reasonably constant supply has been demonstrated during a period of years.

The question may be put why the outflow through the eyes is so constant and maintained over a long period. There are various reasons for this, the principal ones being as follows:—

(1) The intake of water into a given compartment is effected over a wide area varying from seventy to about two hundred square miles. The water's lateral movement, even where the water-level is much higher than at the eye, is subjected to many obstructions and hence it moves rather slowly.

(2) Where water in one compartment is used for irrigation, an appreciable seepage results and thus the relevant water-level rises; this feeds the eye of the following compartment. Thus the water lost through the Bank eye feeds the Oberholzer eye lower down in the spruit.

(3) A similar but more direct effect is achieved by storm water running down the spruit, and by water flowing over the barrier without being turned into irrigation canals, and also by seepage from the latter.

It is clear, therefore, that in the case of these fountains we are concerned with a series of natural sponges and subterranean storage dams that store immense quantities of water, of which only a small surplus becomes available to man and animals. The valley's vegetation, particularly in the neighbourhood of the eyes, has a great variety of specially adapted kinds and harbours an even greater variety of birds that live, breed and sleep there.

VALUE OF THE DOLOMITE EYES

It is obvious that a series of fountains supplying great quantities of water, as already indicated, must be of value for the area in which they occur; this will be dealt with briefly.

In the first place, the water is available for irrigation purposes and is being used for that purpose. That this can be done by means of gravity and irrigating canals simplifies matters. Unfortunately the available soil is rather sour and poor and hence must be heavily manured to yield good crops.

A few years ago a census of the valley's rural population revealed that there were 390 whites, 942 farm labourers and 2,250 squatters. The urban population and miners are not included. At that time there were 314 farming units, one hundred and twenty of which were less than five morgen in size and many but little larger. Experience shows that many, if not most, must be uneconomic, because the required capital is not available to permit of better and more intensive use of the soil. The annual gross income of all the units at that time was R450,000.

It is interesting to note that a Netherlands company, the A-dorp Kommissie voor Wonderfontein, in which shares were held by the Royal House of the Netherlands through the Queen Mother Wilhelmina, in the days of the Zuid-Afrikaansche Republiek, started dairy farming near Oberholzer. There was also a cheese factory that did not close down until about 1936.

At present those parts of the valley that are tilled are planted with lucerne, grasses and legumes. These are almost all used locally in the rather intensive dairying to produce fresh milk for the local and Johannesburg markets. Pig farming is also important, and the production of fat lambs is done on a small scale. In addition wheat, maize, vegetables, fruit and flowers are produced in appreciable quantities for local consumption. On the plains and hills on both sides of the Wonderfonteinspruit there are fairly large herds of cattle. As large areas are devoid of water, some of these herds are dependent upon the fountains for their water.

A few of the fountains with shady trees and running water are favourite recreation spots. During the course of years the Gerhardminnebron eye has become a favourite picnic place, especially for the citizens of Potchefstroom. At present the fountain is partly blocked by concrete walls that turn the water into an irrigation canal along the left left side of the Mooi River Valley. The Boskop Dam a few miles to the south now offers more to the pleasure seeker.

The extensive and comparatively unknown caves between Oberholzer and Welverdiend near the Wonderfonteinspruit are also worth seeing and attract visitors from time to time. In this instance also the Rev. T. F. Burgers gave the following remarkable description of the caves in 1871:—

> "We walk a little further and reach the entrance to the underworld. We descend thirty to forty feet and pass through a narrow open-

ing in the dark antechamber. The candles are now lit and we descend further for the same distance until we reach the floor . . . chilly air blows onto us out of the darkness. The heart beats, not from fear, but from an indescribable feeling of insignificance."

It is said that in the thirties some local farmers explored the caves up to a distance of three miles without reaching the end; they were prevented from going further by the rising water-level. The writer is unable to vouch for this. It is true, however, that here and in the neighbouring Gatsrante there is a rich area of large caves awaiting systematic investigation, study and mapping by trained speleologists.

The variety of birds such as aquatic species, finches, herons etc. that use the water, reedy vleis and trees in the area around the fountains as feeding, breeding and nightquarters provides ornithologists with easily accessible spots for study and observation.

The series of dolomite fountains are not only of importance to geologists and agriculturists, but are one of the most interesting natural phenomena in our country with a wealth of fauna and flora.

In Memoriam:
Percy Poynton Fyfe (1884-1965)

G. P. Visagie

THE farm Lunsklip, better known as the Percy Fyfe Nature Reserve, lies north-east of Potgietersrus in a setting of picturesque granite hills. This reserve is the realization of the ideals of one of Transvaal's great pioneers in the field of nature conservation.

Percy Poynton Fyfe was born on the 7th March, 1884, on the farm Zuringkranz near Senekal in the Orange Free State. Even as a youth he was greatly interested in nature, an interest that he inherited from his Scottish ancestors. He was educated at the Durban High School and later at the Weenen County College in Mooi River, where he was a promising student. When he had completed his studies, he joined a commercial bank in the capacity of cashier and later was transferred to Piet Potgietersrus.

Young Fyfe and his friends were of an adventurous turn of mind, and during week-ends and holidays they explored the area around the village either by train or bicycle. It was on one of these trips that he came across the farm Lunsklip and immediately realized its potential.

After ten years service at the bank, he resigned and bought the farm Lunsklip from Dr. W. J. Leyds for the sum of R4,000, thereby realizing his ideal of possessing his own land. He lost no time in starting farming operations, his first income being derived from vegetables that he sold on the village market.

After the outbreak of the First World War, he joined the South African forces and served in the campaign in South West Africa. On his return in 1918, he married Maria Carolina Fyfe (neé Durandt), the widow of his brother K. B. Fyfe. The marriage was childless.

In 1874 the farm Lunsklip 7 KS, with an area of 3,245 morgen, was purchased from the S.A. Republic by M. J. v.d. Westhuyzen for the sum of three rand. Subsequently it changed owners several times, until is was acquired by Percy Fyfe in 1912 from Willem Johannes Leyds. In 1940 Fyfe sold 482 morgen, and hence the area finally owned by him was 2,932 morgen.

Dr. Leyds did not farm himself but allowed a Bantu chief to hire the farm. By 1912 the Bantus had increased to about 800 with catastrophic results on the soil, the vegetation and the animal life. Percy Fyfe got rid of the Bantus with as little delay as possible and began to apply intensive soil conservation measures. Thirteen camps were made and provided with the necessary water, veld fires were controlled and the vegetation and wild animals strictly protected. In order to provide wood for farm use, he planted several morgen with eucalyptus and wattle trees. The result was that the veld recovered rapidly and was soon able to support a large number of cattle.

During the great drought of 1933/4 the farm's water supplies decreased rapidly and the spruit that had previously always had water dried up. But this calamity could not discourage the progressive farmer. He immediately set about building earthen dams and concrete weirs at suitable places. Today there are more than fifty dams on the farm, the spruit is flowing again, large areas formerly denuded by erosion are once more covered with grass and the dongas of yesterday are now green vleis.

In the early thirties Fyfe had quite a number of sheep on his farm, but they suffered greatly from the depredations of jackals. To reduce the losses he took active steps against the marauders, but with little success. One evening he inadvertently shot his fine stud ram in the head and there and then decided to get rid of the sheep. To fill the gap in his farming operations, and mindful of the manner in which game was being ousted by the advancing civilization, he acquired six Blesbok in September, 1933, from the Somerville Game Reserve in the O.F.S. This small nucleus in the course of time became one of the best-known Blesbok herds in the Transvaal.

In the modern concept game conservation is combined with utilization, and in this respect the late Mr. Fyfe was undoubtedly a pioneer.

As he became older, he denied no creature the right of existence and hence towered head and shoulders above most of his contemporaries. One morning in February, 1964, he summoned me to pay off a score on a Vervet Monkey that was troublesome in his vineyard. After I had missed the animal conspicuously for the fourth time and very audibly began to blame the dilapidated .22 rifle, he laughed heartily and assured me that the magazine was loaded with shot cartridges to ensure that the culprit was not seriously injured.

His love for animals was well known. A troop of baboons that did great damage to his maize was fired at, but the terrified and screaming

Mr. and Mrs. Percy Fyfe.

young orphan that clung disconsolately to its mother was carefully reared and remained his constant companion on the farm for 15 years. She was faithful to her master but jealous of any female that came too near him.

In his area the late Mr. Fyfe was an esteemed and respected farmer and friend. He was good at everything, always willing to help and prepared to assist by word and deed. He was also a member of diverse charitable and farmers' organizations.

His fine sense of humour and optimism made him excellent company. His favourite story was that of "Whiskers". In the days when he was a keen hunter, he had a small dog named "Whiskers". When the two were in the veld looking for guinea-fowls and francolins, Whiskers often disappeared in the long grass. To solve this problem, he tied a long turkey feather on to the tail of Whiskers, a plan that worked well and immediately indicated where the dog was when pointing in the grass. The dog became so accustomed to this procedure that in the course of time he would hold his tail straight up for the feather when he saw his master taking the gun.

He led a simple life, but could not tolerate waste; nevertheless no guest ever left with empty hands.

Mr. Fyfe had excellent command of the Zulu language and treated his native employees firmly but with justice. But he would not tolerate dishonesty. A Bantu that helped himself to a pumpkin was compelled to eat it, skin and all, in the presence of his companions.

The absence of children in his home was keenly felt by Mr. Fyfe, but he made his farm a holiday resort for urban children during school vacations.

As he had no heirs and was afraid that his farm might fall into the hands of an owner who would not maintain it, he decided towards the end of 1950 to present it to the Transvaal Provincial Administration for the purpose of a nature reserve. After protracted negotiations it was registered in the name of the Government by Deed of Transfer No. 8827/1953. Mr. and Mrs. Fyfe retained the usufruct, and the Nature Conservation Branch was entrusted with the care of the game, fish and flora. This partnership continued for 12 years with beneficial results for both parties. As a token of appreciation for his great gift, the farm was proclaimed the Percy Fyfe Nature Reserve in the year 1954.

As soon as the farm was transferred, steps were taken to erect game fences and to restock it. At present there are the following kinds of game animals in the reserve: blesbok, impala, black wildebeest, sable antelope, tsessebe, mountain reedbuck, klipspringer, zebra, kudu and eland. Surplus game is harvested to prevent overstocking, and from time to time blesbok are sold to game farmers. To propagate the nature conservation concept among our youth, camping facilities have been provided and are being extended from time to time.

On the 3rd January, 1965, when he was 81 years of age, Mr. Fyfe died from a heart attack in the Pietersburg hospital. About a fortnight before he passed away, I called and greeted him with the customary "Dag, Oom Percy, hoe gaan dit?" His jocular reply was "Don't address me in Afrikaans, old chap; rather ask me 'who's had it?' "

In the near future a memorial tablet will be fixed on a huge granite rock between a number of wild fig trees, of which he was so fond, in memory of this grand citizen of our land.

The Nature Conservation Ordinance, 1967

MR. R. S. FERREIRA (M.E.C.) delivered the following speech at the second reading of the Draft Ordinance on the 7th June, 1967. The ordinance was approved on the 13th June, 1967, and will come into *operation on the 1st January, 1968.*

Mr. Chairman, the object of this Draft Ordinance is to combine the existing legislation on game and other wild animals, vermin, fisheries and indigenous plants in a single measure, and to revise and, where necessary, drastically amend it to conform with the prevailing circumstances. Before explaining the contents of the Draft Ordinance, I shall deal briefly with the background of the existing ordinances and that of the draft.

On the 28th March, 1945, the Executive Committee appointed a commission to investigate and report upon game preservation and allied matters. Under the chairmanship of Mr. S. A. Lombard, Assistant Provincial Secretary at the time, the commission completed its task so speedily that the final report could be signed seven months later on the 22nd October of the same year. Its task was so well done that during the next twenty years legislation on nature conservation was based on the recommendations of the so-called "Lombard Commission".

The legislation to which I refer is the Game Ordinance, 1949, the Vermin Destruction Ordinance, 1949, and the Fisheries Consolidation Ordinance, 1949. Although some amendments have been made to these ordinances during a period of almost 20 years, they are still in operation. In the case of flora conservation, only one Ordinance, No. 4 of 1946, was passed to amend the Native Flora Protection Ordinance of 1940.

In passing, it may be added that the Nature Conservation Branch also came into existence twenty years ago on the recommendation of the Lombard Commission and was then known as the "Department of Fauna and Flora"under the direction of a "Conservator of Fauna and Flora".

Since 1945—the year of the Lombard Commission and the founding of U.N.O.—great changes took place in South Africa and the rest of the world. Ordinary amendments of covenants and ordinances no longer suffice for the changed cimcumstances. The transformation that the concept of "nature conservation" has undergone in the meantime resembles in many respects that of U.N.O., but it is to be hoped with better results.

Like its contemporary, the concept "nature conservation" has become more holistic. Nature is now looked upon as one large whole with interaction between the components. Game and other wild animals, birds, fish and plants are interdependent parts of an all-embracing biological kingdom The concept "vermin" is no longer applicable, since these animals are now looked upon as being aberrant or "problem animals". Yesterday's "problem animals" may be today's "protected game", as in the case of the Aardwolf. The converse is also true. As a matter of fact there is but a difference in degree between an unprotected wild animal that can be freely hunted with the landowner's permission, as for example the springhare, meercats, mongooses, etc., and those that may only be controlled by means of members of a club acting jointly. We are aware of the fact that the clubs are concerned mainly with controlling the Black-backed Jackal, the Wild Dog, the Bushpig, the Vervet Monkey and the Chacma Baboon.

Although the philosophy of nature conservation has changed radically as the result of increased ecological knowledge and a better understanding of biological communities, it is actually in the field of the technical aspect of nature conservation that the most spectacular progress has been made during the past two decades. Twenty years ago the methods were based on negative protective measures that originated from a deep-seated sentiment for the preservation of scarce and threatened species. Today nature conservation is a recognized positive science with highly specialized methods and techniques, in which the professional scientist may obtain a doctor's degree at the University of Pretoria. Preservation on a negative basis (protection) behind barbed wire has been replaced by positive nature conservation (wildlife management), in which there is room for judicious and scientific use (wise use).

In the meantime the habitats of our wild mammals, birds, fish and plants have not remained static. Agriculture has made spectacular advances and farming has generally become more intensive and scientific. In most parts of the Province the extensive unfenced areas of 1945 are now being used for specialized food production in the form of irrigation, dry-land or cattle farming. The farms have become smaller, fencing has greatly increased and modern insecticides are widely used. Poisonous substances have found their way into our streams through waste products from our mines and other industries, sewage water and stable washing agents (detergents).

As in other countries with the same degree of development, many game and other wild animals, birds, fish and plants have perished, mainly because their "lebensraum" has shrunk. At present there are decidedly less of these natural resources in the Transvaal than there were in 1945, and the challenge for nature conservation is greater than it ever has been.

Nevertheless the prospects are not quite as sombre as may be thought, as the following reasons show:

(1) Wild life is a renewable resource that reacts rapidly by increasing in numbers when it meets with sympathetic and expert attention.

(2) Although the numbers of various kinds have sunk to a dangerous low, not a single kind of plant or animal, so far as known, has disappeared from the Transvaal during the past twenty years; in fact one of the most interesting and spectacular kinds—the White or Square-lipped Rhino—has been successfully re-established at various places. There are few countries that are able to lay claim to such a record during the period concerned.

(3) Although the total number of game and the available area have shrunk, the game's distribution is much more satisfactory at present. Since the general development has resulted in much greater control by the farmer over the wild life on his property, his innate love of nature has led to the re-establishment of ordinary as well as scarce species and other animals on many farms from which they had disappeared. The Provincial nature reserves and game farms played an important part in this matter, but it is the landowners to whom most credit is due. More

than three hundred and forty have had their farms, or parts thereof, declared private nature reserves, in fact the total area now exceeds a million morgen. Others have erected game fences and some have started game farming and are providing shooting-boxes on a commercial basis.

(4) That the post-graduate course at the University of Pretoria already referred to was started, was largely on the initiative and with the financial aid of this Administration. Likewise an independent Mammal Research Institute in the same Department of Zoology was established under the direction of Professor Fritz Eloff. Hence the Branch not only has a well-trained professional staff at its disposal, but the men are at present working in the Province together with specialists from overseas, including America, which is the father of national parks and scientific research in them. With the farmers' love of nature and the enthusiasm and scientific knowledge of the Branch's personnel, the future can be faced with confidence.

(5) Finally it is the duty and privilege of this Council during its present session to pass a legislative measure that, after many years of preparation, tries to provide for all the changed conditions and new developments.

Mr. Chairman, I think that Honourable Members will agree with me that it is not necessary to deal with all the provisions of the Draft Ordinance. Many have been taken over as they stand or with slight alterations from the existing ordinances, and I shall deal chiefly with those provisions that are new. They will be dealt with in the order in which they appear in the Draft Ordinance.

Most definitions in clause 1 have been taken unchanged from the existing ordinances. But a number of new or radically altered definitions is included for various reasons—for example, (vi) "Bantu" and (xxxv) "problem animal" replace the obsolete terms "native" and "vermin"; (xlvi) "white person", (xviii) "honorary nature conservation officer", (xxxiii) "poison", (xxvi) "nature conservation officer", (iii) "angle", (xxxviii) "public road", (xxxix) "public sale", (xxiii) "local authority" and (xlv) "weapon" to avoid any possible doubt about the meaning of the words; (xxx) "ordinary game" and (x) "close season" because they are clear concepts and fundamental modifications of the existing legislation; (v) "artificial lure or spoon", (xxii) "live fish", (xxv) "natural bait", (xxviii) "non-spinning artificial fly" and (xi) "set line" because some important existing fisheries regulations are now included in the draft ordinance; (xxvii) "nature reserve", (xiii) "exotic animal" and (xlvii) "wild animal" because some existing concepts are beng combined or amplified.

Clause 2 is an amendment of article 8 of the Game Ordinance, 1949, bringing the provision of the ordinance up to date and in line with the administrative position; the previous Department of Fauna and Flora has for many years been known as the Department of Nature Conservation.

Clause 3 also conforms with the present policy, namely that any protected areas are proclaimed both as a "game reserve" in terms of article 11(d) of the Game Ordinance, 1949, and as a "native flora reserve" in terms of article 2(2)(a) of the Native Flora Protection Ordinance, 1940, and are then known as a "nature reserve". The clause also provides for the establishment of a nature reserve by means of a notice in the Provincial

Gazette and thus no longer by means of a proclamation. A notice has the same value as a proclamation but entails less administrative work. This difference in procedure is also found elsewhere in the draft ordinance.

Mr. Chairman, before proceeding to Chapter I—Wild Animals—of the Draft Ordinance, the attention of Honourable Members is drawn to the fact that in most cases the maximum fines that can be imposed have been increased. In the Cape Nature Conservation Ordinance, 1965, (article 83) as well as the National Parks Act, 1962 (Act No. 42 of 1962, article 23) provision is made for high penalties and in some instances even minimum penalties for serious first contraventions and less serious second infringements. From the draft ordinance before the Council all existing references to minimum penalties have been deleted, since it is felt that such prescribed penalties, especially in the case of technical infringements, conflict with the discretion of the courts. . . .

To a great extent Chapter I deals with the same legislation as that of the Game Ordinance No. 23 of 1949. But a number of basic amendments and additions have been made to conform with the changed conditions to which I referred in the introductory part of the speech.

Clause 6 is the first of these provisions. The only object is to provide for the continued existence of a particular species of protected game found in such small numbers (and possibly also over a wide area) that it is threatened with certain extinction. In such cases the few remaining specimens can be collected and kept in breeding units, whereby their future will be ensured. I am aware of the fact that some Members are of the opinion that this procedure is an infringement of the individual's freedom, but I trust that when the matter has been thoroughly discussed, you will agree that the measures are necessary. The Roan Antelope, the Tsessebe and the Sable Antelope are examples. It is a radical provision fully realized as such, but it has been well considered, as the following will indicate:

(1) Before the game can be captured, the Administrator must be of the opinion that such action is essential for its survival. It is obvious that the Administrator's *bona fides* with this important discretionary power are not open to doubt.

(2) No action may be taken until the owner or occupier of the land has been consulted.

(3) The game will be established on one of the Administration's public nature reserves, all of which are properly fenced, and will be under the care of scientists trained in nature conservation. Redistribution of specimens can be undertaken later and may include the farm from which the animals were originally taken on instructions from the Honourable the Administrator. It is indeed a far-reaching measure, but I feel that the steps taken to protect the owners of the particular kind of game are entirely satisfactory.

(4) As it will be virtually impossible to fix compensation by a method such as arbitration—the export values of such scarce animals are high—the responsibility for equitable treatment is in this instance also assigned to the Administrator.

To provide for the measure of control that the landowner obtains over the game (except protected game) on his property as the result of changed conditions, very important amendments have been made in clauses 7 to 10 in respect of the hunting of ordinary or unprotected game. The concepts and definitions "open game" and "closed game" in the Game Ordinance, 1949, are in this draft replaced by the concepts and definitions "ordinary game" (clause 7) and "close season" (clause 8). At the same time those kinds of game that are "open and closed game" in the First Schedule of the existing Ordinance become "ordinary game" in clause 7 of this Draft Ordinance. Such "ordinary game" will always be "open" unless a "close season" is declared. The provisions of clauses 9 and 10 mean

(a) that a landowner may in future be able to hunt ordinary game *during the open season* without restriction, permit or licence on his own ground. Many members of this Council have pleaded for this during the last decade, namely that the owner shall be master of the game on his farm;

(b) that the parent, spouse, child, grandchild or son-in-law will virtually be able to do the same as the owner if he has obtained the owner's written permission;

(c) that a non-owner (and this has always been our problem) will also be able to hunt ordinary game during the open season if, in addition to the landowner's written permission, he is in possession of a licence valid for ordinary game and hunts in accordance with the conditions and restrictions imposed. (He may hunt when he has a permit as well as the owner's permission.);

(d) that the Administrator may at his discretion issue a permit to a landowner or his nominee to hunt ordinary game even *during a close season* (e.g. in the case of droughts, overstocking or even for the pot).

Mr. Chairman, clause 13 is self-evident if the definition of "nature reserve" is borne in mind as already stated by me. The provisions of article 17 of the Game Ordinance, 1949, are here radically amended in so far as a landowner, parent, spouse, etc. may be exempted from any hunting provision, and that a non-owner may also hunt ordinary game in a nature reserve with the owner's permission, provided that he is in possession of a valid licence. The motive is that there must be no discrimination against the large number of game protectionists who have furnished proof of their sincerity by having their properties declared private nature reserves.

Clause 15 is new; it deals with instances where landowners have had their land fenced in such a manner that various kinds of game cannot escape, whereby owners obtain physical control over their game. Since such game becomes the landowner's property in terms of our common law, it is logical that he should be exempted from any one or all the provisions of the Draft Ordinance in so far as the *hunting* of game is concerned.

Clause 16 is a new but self-evident provision with regard to the poisoning of game. The definition of the word "poison" has been framed in such a manner that this clause also permits the control of the modern and often highly dangerous narcotics used to capture game by means of various kinds of dart-guns.

Clause 17—Prohibited weapons in respect of the hunting of game—is taken from the Game Regulations, Chapter II, regulation 2, of the existing Game Ordinance, 1949, and is self-evident.

Clause 18—Hunting with snare, etc.—agrees with article 16(1) of the Game Ordinance, 1949, except that a bow and arrow as well as a set gun have been added, and that exceptions are made for certain justifiable cases.

Clause 22—Donation of game—is also a new provision. It will now be possible to exercise proper control over illegal hunting, transportation and possession of game by compelling the donor to give the recipient a proper document when handing over the game. In practice it has often happened that invalid letters have been obtained after possession had been taken.

The underlying idea of clause 23—Possession of dead game—is taken from article 28(3) of the Game Ordinance, 1949, and articles 2 and 3 of the Stock Theft Act, 1959 (Act No. 57 of 1959). This is a very valuable control measure.

Clauses 25 and 26 dealing with the keeping, possession, etc. of live game and certain other wild animals have been taken from Chapter VI of the Game Regulations framed under the Game Ordinance, 1949, and clause 28—Importing of wild animals—from Chapter I, regulation 9 of the same Game Regulations. But both clauses 26 and 28 have been amplified to ensure better control.

Mr. Chairman, clause 32 is a new one that has become necessary to control the establishment of small zoos and similar institutions *exclusive of nature reserves and state-aided institutions* like the National Zoological Gardens. There are many members of this Council, Mr. Chairman, that were dubious about this clause. I trust that the position will be quite clear now. Recently the Financial Relations Consolidation and Amendment Act (No. 38 of 1945) was specially amended to enable the Provinces to do this. The objects of the bodies concerned (local authorities, public bodies, business concerns and even private persons) may be worthy, but in many cases the lay-out, accommodation, feeding, hygiene and choice of animals leave much to be desired. This provision enables control to be exercised by means of a permit.

Clause 34 must be read together with clauses 10, 13 and 30. In the latter, as I have already indicated in one case, the landowner who has ordinary game or exotic animals on his land is authorized to allow his parent, spouse, etc. and non-owners to hunt them. Permission must be given in writing and must include the information required by clause 34. It is obvious, therefore, that the landowner will to a large extent exercise the functions of the Branch's permit section, and that approval to hunt must entail the adherence to certain requirements. The latter will be clearly indicated on the hunting licences of non-owners.

Mr. Chairman, Chapter II—Problem animals—is for the main part the same as that of the existing Vermin Destruction Ordinance, 1949 (Ordinance No. 25 of 1949). The provisions embody no new principle, but there are a few matters to which I shall briefly refer.

In connection with clause 35, the attention of Honourable Members is drawn to the fact that the definition of "local authority" in the draft ordinance has been framed so as to include the Transvaal Board for the Development of Peri-Urban Areas. This makes it desirable to redraft the existing article 2 of Ordinance No. 25 of 1949 in case there are any conflicting provisions.

A number of clauses (numbers 39, 40, 45, 46, 55 and 58) are derived in toto or in part from the existing Vermin Destruction Regulations. All amendments were indicated in the memorandum that was sent to Honourable Members. I feel that it is not necessary to devote more time to this.

I may add that clause 42 is now giving the Administrator full power to alter a hunting area but with a relevant notice. This is in fact being done under the existing Ordinance, but by a more cumbersome method and with doubtful validity.

Mr. Chairman, Chapter III — Fisheries — to a great extent covers the same ground as the present legislation in the Fisheries Consolidation. Ordinance, 1949 (Ordinance No. 26 of 1949). What I said under Chapter II is also true here, namely that for the greater part no new principle is involved, that some clauses have been adopted either in toto or in part from existing regulations, and that all references to corresponding provisions have been indicated in the memorandum. I presume that you have all studied the memorandum and noted where the corresponding provisions were indicated.

In clause 59 there is an important amplification, or better a refinement, of an existing principle: if, under certain circumstances, the chapter is not applicable to the catching of fish by an owner or occupier of land, it follows logically that it should not be applicable under the same circumstances to a full-time employee acting on the owner or occupier's instructions. The attention of Honourable Members is especially drawn to the fact that the employee must nevertheless possess a valid licence to angle.

Clause 64 is a new and clear definition of an old principle. It has become possible owing to a new definition of "angle" compared with that of "catching". If read with clause 66, it is quite clear that a licence is necessary to angle and a permit for catching fish in any other manner.

Clause 65 — the power of the Administrator to declare waters trout waters — is an old principle and established custom stated in plain words.

In Clause 71 — Possession of fish — we have the same as in clause 23 in respect of game.

Clause 75 is the only really *new* provision with the object of enabling control to be exercised over certain very harmful aquatic plants. Thus it is well known that the Kariba weed not only became a serious threat to the valuable fish supplies of the dam but to the whole Kariba scheme.

Mr. Chairman, this bring me to Chapter IV — Indigenous plants . . . The substance is found in the provisions of a very old Ordinance, the Native Flora Protection Ordinance (Ordinance No. 9 of 1940). This was refined and adapted to later legislation by the other Provinces (particularly the Cape's Nature Conservation Ordinance No. 26 of 1965) and is influenced by the whole approach to the preceding three chapters of this draft ordinance.

During the past few years there has been an unprecedented interest in plants, for which we are grateful. I do not know who is in the main responsible for this. Was it the Branch's intentional stimulation of interest by means of publications like "Sixty-six Transvaal Trees" or its own "Fauna & Flora Bulletin", the numbering of trees along the roads, the supplying of thousands of trees and shrubs free of charge from its nursery to schools, hospitals, libraries and road depots, the beautiful film "Lilies of the Field" — or was it the drought?

It does not really matter, but I want to draw Honourable Members' attention to an entirely different aspect, namely the danger that an uncontrolled onslaught on veld plants for garden use may entail for the conservation of the flora. Two examples will suffice

(1) The Cycads (genus *Encephalartos* —the best known example is probably the "Modjadji's Palm") are one of the world's most interesting group of plants. Geologically cycads are of greater age than the Coelacanth, that fish of Dr. J. L. B. Smith that is considered to be a living fossil. Although it is in a Bantu area, the Modjadji group has been declared an Historical Monument. About seven different species of cycads occur in the Transvaal in various places, most of them with a very restricted distribution on one or a few farms. Recently I saw a "Modjadji Palm" in the garden of a prominent citizen of Johannesburg, and the owner hastened to explain that it had not been obtained illegally. Unfortunately cycads have become one of the most highly prized garden plants in the land — and in the world. At present they are disappearing so rapidly from their habitats that the only method of ensuring their future is to preserve them in special nature reserves. Hitherto it has been possible to safeguard three of the seven species in small reserves, two on Forestry areas and one on private ground presented to the Administration. Even a State department like the Department of Forestry attaches so much value to these plants in their natural environment that in the case of a small species, *Encephalartos humilis,* pine trees that had already been planted were removed in order to set the locality aside as a nature reserve.

(2) The Aloes (genus *Aloe* — well-known plants) are equally favoured — and the rarer the better. In Dr. Reynolds's book "Aloes of Souh Africa", the exact distribution of each kind is indicated. During the last inspection of the locality of one of the rarest kinds, *Aloe Vossii,* in the Soutpansberg only 23 specimens were found in the veld. In the original locality of the world's smallest aloe, *Aloe albida,* in the Barberton mountains, not a single plant remains. Fortunately specimens of *albida* (generally $3\frac{1}{2}''$ high including the flowers) have been found elsewhere in the same environment and are now safe in a small Provincial reserve which is also a gift. After a long search a few specimens of *Vossii* have also been found elsewhere in the Soutpansberg Mountains, and negotiations are proceeding with the owner.

Mr. Chairman, these examples are not mentioned as horror stories, but to let Honourable Members realize the problems encountered in connection with the legislation in Chapter IV of the Draft Ordinance. On the one hand we do not want to make offenders of our own wives should they give a harmless little aloe to their mothers-in-law on a Sunday morning, and on the other we cannot but remember that South Africa's floral wealth was world-famous long before the discovery of our gold and diamonds. The Cape with the richest flora on earth has already lost one species, a fact lamented by botanists throughout the world. In case some of you wish to know which species it is, I may now say that it is *Chamaealoe africana . . .*

To complicate matters further, there are unfortunately individuals that exploit the popularity of rare species for personal gain, and who do not hesitate to remove them at night-time, smuggle them out of the Province and export them at high prices. *This* cannot be countenanced.

Mr. Chairman, I have briefly described the background against which Honourable Members are asked to consider each provision of this chapter. The object is to control the picking (which includes uprooting), sale, donation, export, removal and possession of protected plants in accordance with the aforegoing chapters without being unreasonable towards the ordinary law-abiding citizen. Virtually throughout the draft this entails provisos whereby exceptions are made for *bona fide* cases without throwing the door wide open for the culprit.

The most that we expect of our women is to hand their mothers-in-law a letter stating that the aloe has been presented as indicated in Clause 81(3). I am convinced that they will do this most willingly if they are aware of the object and background of this provision. The principle is merely a repetition of clause 22 — Donation of game — as applied to the latter.

In this connection I would like to draw attention to clause 83 which provides that the owner of a registered nursery may be exempted from any or all the provisions with regard to the sale, donation, transportation or export of protected plants that he has grown.

Mr. Chairman, this brings me to the last chapter — Chapter V — of the Draft Ordinance. It includes a great number of *general* provisions extracted from the existing Ordinances, especially the Game Ordinance 1949 (Ordinance No. 23 of 1949) and adapted to the wider field of this draft measure . . .

Except for clauses that have been renumbered, Honourable Members will realize from the references in the memorandum that hardly any new principle is at stake in this Chapter.

Even clause 103 (now 104) — Powers of owner, occupier or supervisor of land — has its essence in the existing legislation; it is, furthermore, in agreement with the general purport and spirit of the Draft Ordinance. The new presumptions in clause 104(8) and (10) in connection with the keeping of animals in captivity may be considered to be consequential amendments of the provisions of clauses 25, 26, 31 and 32.

Clause 109 (now 110) succinctly states that the Administrator may exempt any person from anyone or all the provisions of this draft measure, if he feels that this is in the interests of nature conservation; this is a suitable summing up of the measure as a whole.

Clause 110 (now 111) — "This Ordinance shall not bind the State" — is a clear provision agreeing with the legal opinion on the existing Ordinance.

Mr. Chairman, I have now sketched the most important new and amended provisions of the Draft Ordinance, but, as I have already stated, this survey is by no means complete; it is impossible to deal with every amendment in full detail. Apart from the new and amended provisions, there are numerous other minor amendments of a practical nature (also in the Schedules attached to the Draft Ordinance) that do not involve principles, but that aim at making nature conservation more successful and realistic. These minor amendments are obvious when the Draft Ordinance is studied.

The Draft Ordinance is very extensive and has necessitated intense and careful preparation, but I feel that it is a great improvement on the existing Ordinances. An attempt has been made to include the knowledge and experience of the past in the draft, and I trust that this legislation, like the existing Ordinances, will also remain in operation for twenty years. I would like to avail myself of this opportunity to express my thanks to the Director of Nature Conservation and his personnel, the Law Advisers, the Advisory Board, all Honourable Members and many organizations and individuals who have helped, and I would like to congratulate them on a fine piece of work. Since nature conservation is one of our greatest national assets, I have thought it necessary in the national interest to circulate the draft among Honourable Members, so that each would have the opportunity to make a personal contribution. And I thank those Members that did make contributions.

The farming community and many other members of the public have awaited this legislation impatiently, and I trust that it will be well received and so well supported that it will make a valuable contribution to nature conservation in the Transvaal.

Mr. Chairman, I now move the Second Reading of the Draft Ordinance.

Publications

The following list of publications in scientific journals is supplementary to the one published on page 42 of the Fauna and Flora Bulletin, No. 17, 1966:—

51. Farkas, T., 1964. Notes on the Breeding Activities and Post-embryonic Development in the Mocking Chat *Thamnolaea cinnamomeiventris cinnamomeiventris* (Lafresnaye). The Ostrich, Supplement No. 6: 95-107.

52. du Plessis, S. S. and le Roux, P. J., 1965. Sport Fisheries in River Development with Reference to the Orange River Scheme. S. Afr. J. Sc., 61(3): 137-146.

53. du Plessis, S. S., 1966. Stimulation of Spawning in *Xenopus laevis* by Fowl Manure. Nature, 211 (5053): 1092.

54. Bothma, J. du P., 1966. Food of the Silver Fox *Vulpes chama*. Zoologica africana. 2(2): 205-209.

55. Farkas, T., 1966. The Birds of Barberspan III. Some Structural Changes in the Avifauna of the Barberspan Nature Reserve. The Ostrich, Supplement No. 6: 463-491.

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The photo on the outside of this page is of a euphorbia in Schoemanskloof.
Photo: J. Balcomb.

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TUA CONSERVA

In the north-eastern Transvaal *Official photo*

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[illegible] *Secretary*: Mr. J. G. van der Merwe
Acting Director of Nature Conservation: Mr. S. S. du Plessis, M.Sc

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ERRATA

Page 60. Line 20 from the top must come immediately after line 22.

Page 63. The captions must read as follows:-

Fig. 2 (the left one). The Elephant Louse *Haematomyzus elephantis* Piaget.

Fig. 3 (the right one). *Damalinia martinaglia* Bedford, host-specific on the Red Lechwe (*Kobus leche*).

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ADMINISTRATION OF THE PROVINCE OF TRANSVAAL

Administrator: The Honourable S. G. J. van Niekerk
Provincial Secretary: Mr. J. G. van der Merwe
Acting Director of Nature Conservation: Mr. S. S. du Plessis, M.Sc

OUR LIVING SOIL

H. P. v.d. SCHIJFF, A. EICKER and
G. K. THERON

Department of General Botany, University of Pretoria

Wherever we happen to be in this land of ours, we come across people working with the soil. In Vendaland a simple Bantu woman is busy loosening the soil with a hoe; in the Transkei a piccanin urges on a cow to pull a simple plough; in the Orange Free State a large tractor roars across the grass-veld ripping up the soil with a five-disc plough, and in Johannesburg a miner is busy in the back yard of his garden loosening the earth around dwarf beans.

Like those living elsewhere in the world, we are also busy in South Africa in working with the soil. We dig and cultivate, plough and harrow it so that it may stimulate the growth of its plants - one plot to yield tenfold and another hundredfold - for "God said, Let the earth bring forth grass, the herb yielding seed and the fruit tree yielding fruit after his kind, whose seed is in itself, upon the earth: and it was so".

"And the earth brought forth grass, and herb yielding seed after its kind, and the tree yielding fruit, whose seed was in itself, after his kind: and God saw that it was good".

In his innermost nature every person is a gardener or argriculturist. Whether he lives on a remote farm in Bushmanland or in the heart of Johannesburg, he not only finds relaxation in working with the soil, but is entirely dependent upon it for food. Even a child will rather play in a heap of sand or splash in mud than amuse itself with a modern toy.

Tilling the soil is the most basic occupation of mankind. All our food is derived from it, and if the soil is cultivated carefully and with discretion, it is able to meet all our needs. But its capacity is not unlimited, and this holds good for all soils. The soil is the source of food for plants, but if the food removed by plants is not replenished, the soil will become impoverished and the plants growing in it will no longer yield crops but shrivel up and die. The life-giving soil will become sterile and force the farmer off the land. The survival of mankind in general and of a nation in particular can only be assured if the soil remains a living soil.

In the beginning there were only rocks on the earth's surface, barren and inhospitable rocks without life and in which life could not exist. There were no living organisms; plants were absent since there was no rain. The rain came when water vapour condensed. When the clouds shed their contents on the earth, little streams began to gurgle on the barren rocks - and the process of erosion had commenced. Winds blew particles of sand against the rocks, and the hot sun made them expand, a process that was followed by contraction. This, together with the constantly repeated effects of winter and summer, led to the formation of small cracks. Rain-water found its way into the latter, and when it froze rock-flakes were split off through the great pressure.

The action of the elements continued for many aeons, and in the course of time the earth was covered with a layer of powdered rocks. Some of this remained where it was formed, but some was carried away by wind and water to be deposited elsewhere, while the primary layers of soil together with the rocks were moved by the immense power of glaciers.

Living organisms were now provided with a substratum on which they could exist. Plants established themselves in the layer of powdered rock anchored by means of their roots, and through the latter they were able to absorb mineral nutrients that also nourished the leaves, in which carbohydrates were formed under the influence of light.

Trillions of organisms originated on the earth. The whole gamut of biological forms from the smallest unicellular plants and animals to the largest trees and antelopes was then present on the earth and was then, as now, dependent upon the soil. These organisms are constantly dying and decomposing, their remains becoming mixed with the powdered rock material; in this manner foodstuffs are incorporated in the soil and become available to organisms. The process is an uninterrupted cycle of life and death.

In the course of time the upper layers of the earth were covered with a complex mixture of materials. Where eroded rock material once existed, the soil now consisted of a mineral substratum intimately mixed with the already decomposed and decomposing remains of organisms. Thus the inhospitable layer now became the abode of thousands of different kinds of organisms, such as bacteria, moulds, algae and many other micro-organisms living in dead organic material or on one another.

There are numerous kinds of small animals, insects and plant-roots that live in the soil and on dying contribute towards the ecosystem to which we assign the name "living soil". This powdered, eroded and at one time lifeless rock stratum now became a layer pulsating with life. It is the home of thousands of organisms from the simplest unicellular kinds to the most highly developed kinds of plants and animals.

Plants grow luxuriantly in this living layer, whereas the animals roaming on its surface are dependent upon them for their sustenance. These animals and some kinds of plants provide human beings with their food. It is obvious, therefore, that the upper layer of soil cannot be considered to be a lifeless mass. The soil is no more a mass of dead rock material than a town is a mass of brick and concrete buildings.

SOIL ORGANISMS AND THEIR MODE OF LIFE

For the sake of convenience, soil organisms are classified according to their size as micro-organisms and macro-organisms. The former can only be studied properly by means of a microscope; they include bacteria, the Actinomycetes, Protozoa, Fungi and Algae. Although viruses are strictly speaking not organisms, they are generally included among the micro-organisms on account of their reproductive capacity; most of them are only visible through an electron microscope. The macro-organisms (macro-fauna) constitute the remaining soil organisms. They include tiny animals, like mites and nematodes, many of which are visible to the naked eye whereas some are fairly large.

VIRUSES AND BACTERIOPHAGES

Viruses are the smallest units capable of reproduction and can only be seen under the electron microscope. All are obligate parasites, and although they can survive outside a host, they reproduce themselves only within the living host. Viruses can be divided into four main groups, namely those that are responsible for diseases in human beings and animals, insect viruses, plant viruses and viruses that parasitize bacteria (bacteriophages). Although our knowledge of the virus and bacteriophage populations of the soil is still very fragmentary, and little is known about their direct importance in soil biology, it must be accepted that in view of their parasitic mode of life they are of special importance in so far as the biology of the rhizosphere is concerned. Some of the more stable plant viruses, such as the tobacco mosaic virus, are able to survive in the soil for several months in a resting condition, and may then be responsible for a new infection. Viruses and bacteriophages are of special importance in soil biology, because they are responsible for diseases in more complex soil organisms.

BACTERIA

Of all the soil's micro-organisms the bacteria are certainly the most abundant. Most soil bacteria are beneficial to plants owing to the fact that they play an important part in foodstuff cycles. But some kinds are harmful, since they are either parasites giving rise to serious plant diseases or compete for the available food supply.

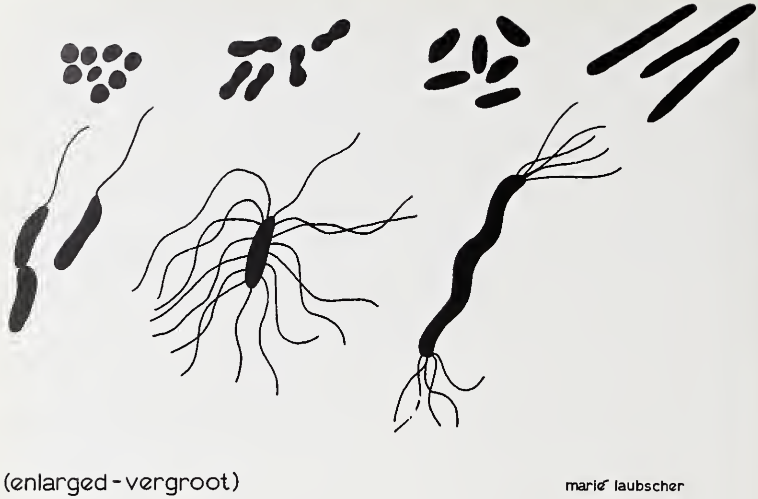


Fig. 1 *Characteristic morphological forms of a few kinds of bacteria.*

It has been estimated that a gram of good agricultural soil may contain as many as 10^9 bacteria which is equivalent to more than 3,000 pounds per acre. According to Bergey's Manual (Breed et al., 1957), more than fifty genera with 150 species of bacteria have already been isolated from soils. According to their modes of feeding, soil bacteria are divided into two large groups, the heterotrophic and the autotrophic bacteria. Heterotrophic bacteria need an external source of organic material for their carbon and energy requirements and are by far the most abundant. On the other hand autotrophic bacteria, a much smaller group, obtain their carbon requirements from the carbon dioxide in the atmosphere and their energy through the oxidation of organic substances or even directly from sunlight. They play a very important part in certain chemical changes in the soil that are of importance for the nourishment of higher plants.

Examples of autotrophic bacteria are the nitrifying bacteria, the sulphur bacteria and the iron bacteria. Among the heterotrophic bacteria there are forms that are able to utilize a large variety of organic substances in the soil, such as sugar, cellulose, chitin, organic acids, alcohols and various other carbohydrates.

Various kinds of soil bacteria are able to fix free atmospheric nitrogen and make this essential element available to other plants.

ACTINOMYCETES

The Actinomycetes have characters common to both fungi and bacteria, but are more closely related to the latter; at present they are generally classified among the bacteria. Representatives of the Actinomycetes are found in large numbers in the soil. In neutral or alkaline soils they may be as abundant as bacteria, but as they are very sensitive towards acids, they are relatively scarce in acid soils.

The large family known as the Streptomycetaceae consists almost entirely of soil forms. They play an important part in the decomposition of organic material in the soil. Some kinds are responsible for plant diseases, whereas others produce important antibiotics such as streptomycin, Chloromycetin and aureomycin.

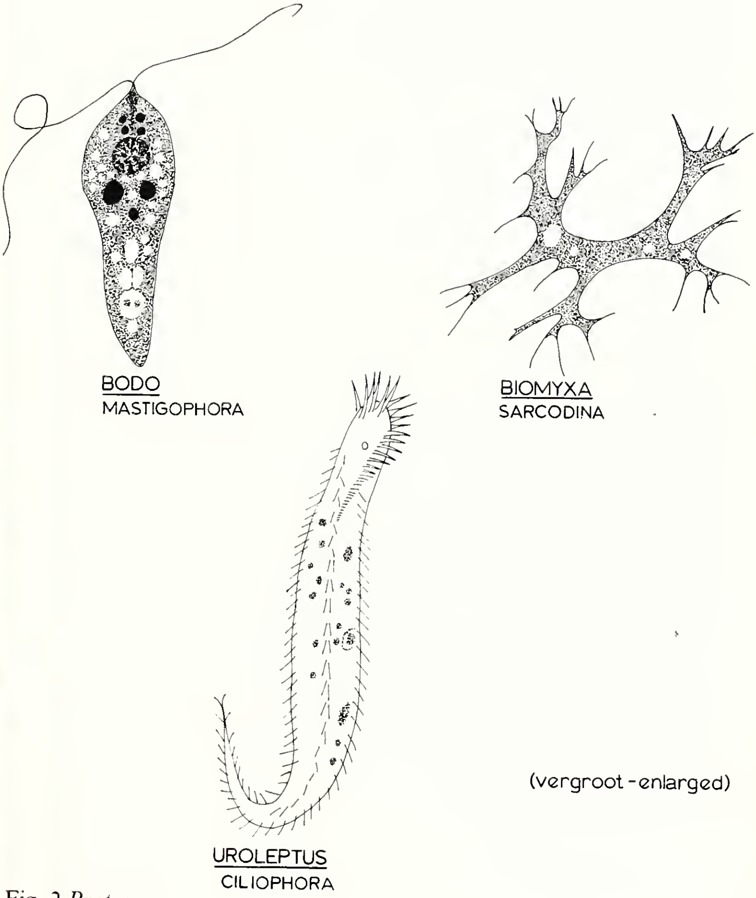


Fig. 2 *Protozoa*

PROTOZOA

The Protozoa are a group of tiny and simple animals that live mainly on bacteria. With a few exceptions they are all microscopic unicellular forms without a definite organization. The free-living non-parasitic kinds are usually divided into three groups: the Sarcodina (creeping forms), Mastigophora (flagellate forms) and the Ciliophora (ciliates).

The Sarcodina comprise two definite types, those that consist of a mass of protoplasm surrounded by a thin elastic membrane, and those that are provided with a firm outer skeleton of chitin or silica. Filamentous pseudopodia extend through openings in this skeleton. Both types are amoeboid and can produce resistant cysts.

Flagellate Protozoa are types that can swim freely in the soil's water by means of flagella at one end of the body. The ciliates or Ciliophora are also free-swimming forms, but differ from the flagellates in being provided with many cilia that often cover the whole body and in some cases are arranged in bands. The cilia also help to bring food particles to the organism's mouth.

Counts made of the Protozoa fauna of the soil have shown that the amoeboid and flagellate types are much more abundant than ciliates.

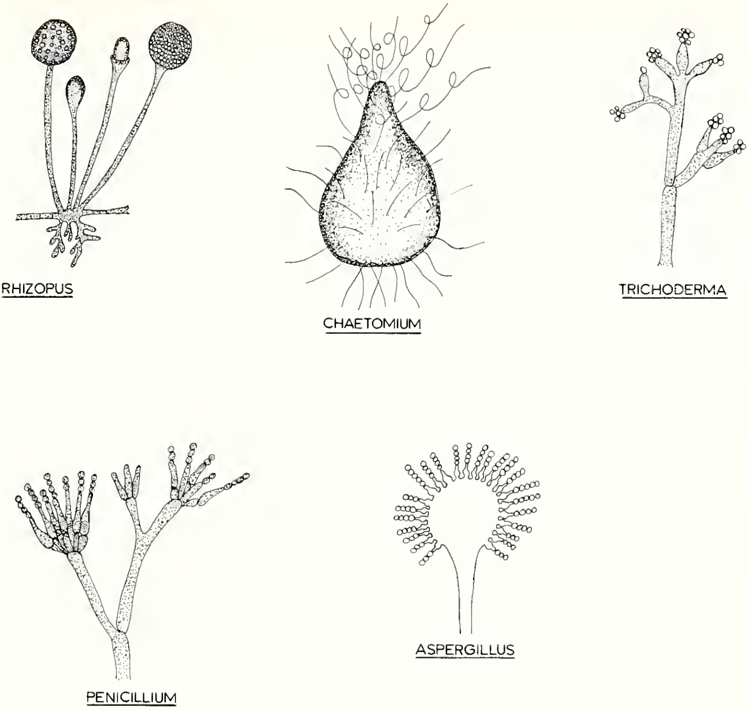
Protozoa live on bacteria large quantities of which are consumed in the soil. But they also live on the smaller kinds of algae, yeast cells and even other Protozoa, whereas some kinds live saprophytically on dead organic material.

FUNGI

Fungi are as important a component of soil micro-organisms as bacteria and also play an important part in soil processes, especially in the case of neutral and alkaline soils, in making food available to plants.

In acidic soils fungi are more active than bacteria. According to Gilman (1945) more than 600 different kinds of fungi had been isolated from soil up to 1945; if the research work on this group since then is taken into account, it must be accepted that many more kinds are now known. Among others the most important and widely distributed fungi isolated from the soil belong to the following genera: *Absidia, Acrostalagmus, Alternaria, Aspergillus, Botrytis, Cephalosporium, Chaetomium, Cladosporium, Cylindrocarpon, Fusarium, Mucor, Penicillium, Rhizopus, Stemphyllium, Trichoderma, Verticillium* and *Zygorhynchus*. It must be emphasised, however, that the method of isolating fungi plays a very important part in the kinds that are found.

Fungi occur as saprophytes, parasites and symbionts in the soil. Like the bacteria, saprophytic fungi have a great diversity of food on which they live. Thus one group is able to break down lignin, whereas this



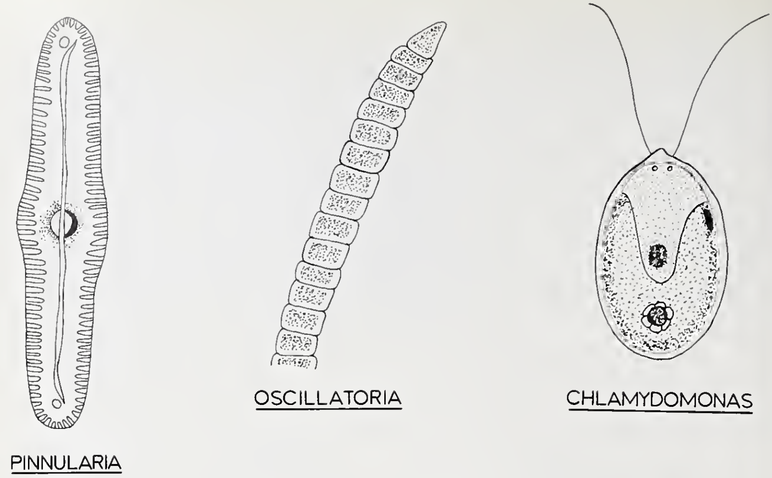
(enlarged - vergroot)

marie laubscher

Fig. 3 *A few typical soil fungi*

substance can be digested by very few, if any, bacteria. For this reason fungi are looked upon as being the primary organisms that are responsible for the decomposition of woody tissues in the soil. Fungi also break down cellulose, chitin, keratin and other organic compounds in the soil.

The fungi are of very great importance because the vast majority assists in the essential decomposition processes of organic substances in the soil. But there are also harmful kinds that cause economically important root diseases in plants. Apart from these parasitic species, there is also a group of fungi that parasitizes tiny soil animals like nematodes (eel-worms). These fungi have very interesting modifications that enable them to capture eel-worms in the soil and digest them.



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marie laubscher

Fig. 4 *Soil algae*

ALGAE

Algae are abundant in soil, but sufficient is not yet known about them to permit generalization.

Owing to their autotrophic mode of life, algae are generally found on the surface of the soil or in the uppermost layers, since they are dependent upon light; but sometimes algae cells are present in deeper layers. Their presence in the latter is probably due to the downward movement of water. At these depths the cells are able to survive for appreciable periods by making use of reserve foodstuffs. But there are some kinds that grow heterotrophically in the dark and may, therefore, be permanent inhabitants of the deeper layers of the soil. Representatives of the green algae (Chlorophyceae), that include genera like *Chlorella*, *Hormidium* and *Chlamydomonas*, are very abundant in the soil. Under moist tropical conditions blue-green algae (Cyanophyceae) form a continuous layer on the surface of the soil and contribute to its fertility, since many kinds are able to fix atmospheric nitrogen. Diatoms (Bacillariophyceae) are also present in the soil, whereas yellow-green algae (Xanthophyceae) are seldom present and red algae (Rhodophyceae) are very seldom present except in abnormally alkaline soils. In this connection *Porphyridium* is an important genus.

It is generally accepted that green algae affect the growth of plants mainly in four ways. Certain kinds of Cyanophyceae are able to fix atmospheric nitrogen, whereby the nitrogen content of the soil may be appreciably increased after they die. Dead algae also contribute an appreciable amount of organic material to the soil, and help to bind soil particles on the surface. In marshy parts algae play a part in improving soil aeration.

MACRO-ORGANISMS

(Macrofauna)

There is a remarkable wealth of animal life in the soil with a great variety of species. The soil fauna varies from microscopic small Protozoa to large vertebrates like snakes, moles, hares and antbears. Some kinds like earthworms, Symphyla, Protura, mites and Collembola live permanently in the soil. Others like fossorial rodents, reptiles, amphibians and many insects spend only part of their life in the soil and hence are temporary soil-dwellers.

Various criteria may be used for classifying the soil fauna. They can, for example, be divided into two groups depending upon whether they are able to make their own burrows or not. They may also be classified according to their feeding-habits. Phytophagous species are those like snails, many insects and larvae, as for example wireworms, that live on vegetable matter and are sometimes responsible for serious plant diseases.

Saprophagous kinds are animals like earth-worms, millipedes and many kinds of insects like ants, termites and some kinds of larvae that live on dead plant substances. Carnivorous kinds are types like golden moles, centipedes and many kinds of beetles. The principal characters of some kinds of the most interesting representatives of the soil fauna are briefly discussed in what follows.

Arthropoda

Many kinds of Arthropoda (animals with segmented limbs) are present in the soil; one of the most important groups is that of the mites (Acarina) that are related to the ticks, spiders and scorpions. They vary in size from 0.1 mm. to 2 mm. and live on dead vegetable matter, bacteria and fungus spores and are even parasitic on other kinds of soil fauna. It has been established that about 70% of all kinds of soil Arthropoda live in the uppermost five to six inches of the soil.

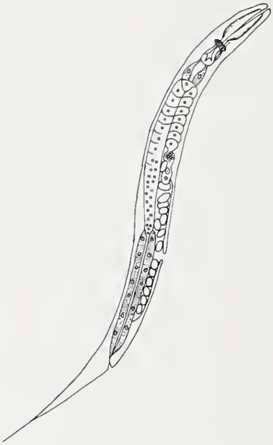
The Chilopoda (centipedes) are generally carnivorous (flesh-eaters), but some kinds live on vegetable matter. They occur principally in forest soil but also in grassveld. The Diplopoda (millipedes) are for the main part forest forms. They are entirely herbivorous feeding on vegetable matter in various stages of decomposition. Millipedes consume large amounts of leaf material in the soil voiding it as excrement. The latter is more easily assimilated by fungi than fresh leaves.

Many insects are also found in the soil. Some of these, like the wireworms (Coleoptera larvae) and cutworms (Heterocera larvae), are responsible for damage to economically important crops. Other harmful kinds found in the soil are grubs and stalk-borers, whereas ants and termites play an important part in soil fertility. Frequently they are pioneers in newly denuded soil; through their activities they create more favourable conditions for other kinds of soil fauna like collembollans and mites.

In the Bushveld areas of South Africa the vegetation on termitaria (ant-heaps) differs strikingly from that of the surrounding veld; these differences can only be attributed to the activity of termites. According to Murray (1938) the percentage of humus, nitrogen and colloids and the maximum water-retaining capacity of the soil of ant-hills is higher than that of the soil of the immediate surroundings. In the Kruger National Park termitaria are found both on raised ground with good drainage and on low-lying areas with poor drainage that is sometimes subject to waterlogged conditions. In the first case the termitaria provide a damper and better aerated habitat, whereas in the other case they provide a better and drier aerated habitat.

Nematoda

Soil nematodes are small cigar-shaped worms that vary from 0.2 mm. to 0.5 mm. in length. At the head end they are truncate with a centrally placed mouth, whereas the tail tapers and ends in a point.



(vergroot - enlarged)

Fig. 5 *A nematode*

Nematodes vary in habits from free-living saprophytic forms to specialized parasites on bacteria, Protozoa and even on other nematodes as well as higher plants and animals. Among the best-known nematodes are the eel-worms that are able to cause serious damage to the subterranean parts of plants. Once the soil is infected with these worms, it is a very difficult matter to get rid of them. They form a resistant cyst that can withstand desiccation and may give rise to a new colony of nematodes after having remained in the soil for many years. The activity of eel-worm eggs is stimulated by secretions of the roots of the host-plants. In most cases eel-worms are host-specific.

Oligochaeta (Earth-worms)

For soil fertility earth-worms are undoubtedly some of the most important organisms present in the soil. They are responsible for striking changes in the soil and hence may have far-reaching effects on other soil inhabitants. Much has been written and there has been great speculation about the importance of earth-worms for both the soil flora and other plants. The innumerable tunnels that they make improve the penetration of rainwater into the soil and also its aeration. Vertical tunnels that may penetrate to a depth of several feet may contribute towards the better drainage of some kinds of soils. They are also able to dig the soil up thoroughly, thereby bringing about not only a thorough mixing of the lower and the upper layers, but also increasing the depth of the fertile soil. As far back as 1881 Darwin suspected that earth-worms increase soil fertility because they carry organic material from the surface into the soil. The tunnels made by them in the soil also provide suitable habitats for many kinds of soil microflora and microfauna. They also make it easier for plant roots to penetrate the soil. Since earth-worms take in mineral particles together with the organic material, their faeces consist of a mixture of clay and humus, and thus the main soil constituents are not only brought into close contact with each other, but a better granular texture of the soil results. Earth-worm faeces are also an ideal medium for the growth of many kinds of bacteria and fungi.

THE PART PLAYED BY SOIL ORGANISMS IN FOOD-CYCLES

The fertility of all kinds of soils is dependent upon the foodstuffs that find their way into the soil in the form of organic materials, and that are broken down to a stage in which the plant is able to absorb them.

In addition to hydrogen and oxygen that are available in unlimited quantities, carbon, nitrogen, phosphorus and sulphur are some of the most important elements required by plants and other living organisms. But if these elements are constantly removed from the soil without being replaced, it will in time become so exhausted that plants could hardly grow in it. But under natural conditions there is a food-cycle during which complex organic compounds of plants and animals are broken down to simple compounds that again become available to plants in the soil.

The important part played by some of these organisms in this food-cycle will now be briefly dealt with.

The carbon cycle

In dealing with the carbon cycle, it is convenient to begin with the plant that obtains its carbon from the carbon dioxide in the atmosphere and fixes it by means of photosynthesis in the form of complex organic compounds. By means of the process of respiration carbon in the living plant is either set free directly into the air in the form of carbon dioxide, or by means of the roots finds its way into the soil in the form of amino acids and other organic compounds. But most of the carbon is retained in the plant as cellulose and lignin or as structural elements of protoplasm and reserve foodstuffs.

When the plant dies, all carbon compounds in its body must be broken down to compounds that can be assimilated by living organisms.

All organic material in the soil must be broken down to carbon dioxide that finds its way into the atmosphere. This process may involve many stages, some of which are complex, before the carbon dioxide is set free.

In all food-cycles carbon is transferred from one organism to another, a part being set free as carbon dioxide, and a part being fixed as new tissues and/or being excreted in the form of transformed carbon residues.

When plant and animal remains decompose, it is the carbohydrates, lipides and proteins that decompose most readily and the products of which become available to other organisms. Cellulose, lignin and suberine are not so easily broken down and must often be attacked by fungi or bacteria or consumed by microfauna. The latter digest part of the plant body and excrete waste products that serve as food for other organisms.

The preliminary decomposing activities of the microfauna result in increased microbic activity in the finer material. In this manner a larger surface is exposed to the micro-organisms with a better distribution in the soil. All the decomposing organisms like bacteria, fungi, mites and nematodes respire and give off carbon dioxide to the air. The complex organic compounds built up by micro-organisms are easily broken down by others and form the humus fraction that decomposes very slowly.

Not only the dead plant remains are subject to decomposition. Parts of plants are consumed by herbivorous animals and human beings and hence do not decompose in the soil. Part of the carbon derived from living plants is turned into carbon dioxide during the process of respiration and is set free, whereas a part is returned to the soil in the form of excreta and dead bodies. Where carnivorous animals come into the picture, the carbon derived from plants passes through different animals before carbon dioxide is set free.

At the present time another important source of carbon dioxide is the combustion of "fossil fuel" like coal, oil and petroleum products.

The nitrogen cycle

The carbon and the nitrogen cycle have certain common characters but also several important differences.

In general there is more nitrogen than carbon in the atmosphere; except in the case of a few kinds of organisms, nitrogen cannot be assimilated direct from the air. In the same way as carbon, nitrogen is given off into the soil in the form of organic compounds through the roots, or it is added to the ground in the form of plant remains.

Soil bacteria and certain kinds of fungi are responsible for two important processes whereby organic nitrogen is made available to plants in the soil. In the first place organic compounds rich in nitrogen are converted into inorganic substances like ammonia and ammonium salts through the action of soil minerals. In this case the micro-organisms live on a medium rich in nitrogen, like proteins and nucleic acids, and only the surplus nitrogen is converted. This process is also known as ammonification. Secondly, nitrification takes place, that is to say the ammonium salts are converted to nitrites and nitrates. Since plants absorb nitrogen mainly in the form of nitrates, this process is most important. The nitrifying bacteria (e.g. *Nitrosomonas*) live autotrophically and obtain their energy from the oxidation of ammonium salts to nitrites and nitrates: The first step in nitrification is not beneficial to the plant, since nitrites are toxic, and the plant is even less able to use the ammonium salts. Fortunately the nitrites are oxidized as quickly as they are formed to nitrates.

Nitrates are a good source of nitrogen for the plant, but as they leach out readily much of the nitrogen is lost. Not only does leaching take place, but by means of denitrification through anaerobic bacteria (*Pseudomonas denitrificans*) and the action of fungi they are converted into oxides of nitrogen that are given off to the air. This process results in a nett loss of nitrogen from the soil and is usually found in poorly drained soils, or in other words where there is a lack of oxygen.

In cases where there is a very high ratio of nitrogen to oxygen, nitrogen may be abstracted from the cycle. In such cases the micro-organisms generally require more nitrogen than is available and thus deprive the higher plants because they cannot compete with the micro-organisms. But this is a temporary phenomenon, since the fixed nitrogen is set free again as soon as the carbon/nitrogen ratio is restored and the micro-organisms die. But whenever plant substances rich in carbon are ploughed in, as for example hay, it is essential that a fertilizer rich in nitrogen is added.

The natural addition of nitrogen from the air results from the presence of ammonium and nitrate ions in rain-water and from the biological fixation of atmospherric nitrogen.

The biological fixation of nitrogen is brought about by bacteria living symbiotically with higher plants, e.g. *Rhizobium,* or free-living non-symbiotic bacteria such as *Clostridium* and *Azotobacter*. The symbiotic or nodule bacteria are found mainly on the roots of plants belonging to the Leguminosae (pod-bearers); it has been established that these bacteria can fix up to 500 lbs. of atmospheric nitrogen per acre per year. Equally important are the non-symbiotic bacteria, since it has been found that in the absence of legumes they can fix up to 130 lbs. of atmospheric nitrogen per acre per year in comparison with 200 lbs. of nitrogen per acre per year where legumes are present (Jackson and Raw, 1966).

Not only is free nitrogen fixed by bacteria, but also by blue-green algae. In the rice-fields of the East these algae are important fixers of nitrogen.

The sulphur cycle

Like nitrogen sulphur (sulphates) is one of the most important constituents of all living organisms.

In the soil sulphur occurs mainly as a component of organic compounds and is not freely available to plants before it has been converted to sulphates by micro-organisms. But plants are able to absorb amino acids containing sulphur, cystine, cystein and methionine, but these form a very small percentage of a plant's requirements.

Under anaerobic soil conditions the organic sulphur compounds are converted into sulphuretted hydrogen (H_2S) and sulphides. The sulphuretted hydrogen is set free, whereas the sulphides are oxidized to sulphates by micro-organisms (bacteria and fungi).

With the help of bacteria (*Desulfovibrio*) soil sulphates may also be reduced to sulphides and sulphur and the sulphuretted hydrogen that is liberated finds its way into the air.

The phosphorus cycle

Phosphate is an essential constituent of various important compounds present in plants and animals such as nucleic acid and phospholipides.

In soil phosphate is present both in the form of inorganic salts and as organic compounds, and in view of the fact that most plants can only take up phosphates in the form of orthophosphate ions (H_2PO_4), all phosphatic compounds must be converted to that form before they can be absorbed by plants. Plants with mycorrhiza may be able to make use of those inorganic phosphates that cannot otherwise be absorbed.

The organic phosphate in the soil is derived from decomposing animals and plants, from excreta and to a lesser extent from dead micro-organisms. The latter as well as other plants compete on virtually the same level for the phosphates available from this source.

Phosphates that are applied in the form of fertilizer are usually fixed chemically in the form of non-available organic salts. But by means of the action of bacteria and fungi, such phosphates may be converted into available orthophosphate.

SUMMARY

During the present year every South African is being reminded through the festival of the soil that the latter must be a living soil in order to give life to others and maintain it. In this brief survey of the numerous organisms that are an integral part of the soil, an attempt has been made to emphasize the importance of the responsible and judicious use of the soil. It has been shown that soil organisms play a very important part in the flow of foodstuffs in the soil. Where soil is cultivated, this flow is drastically changed and disturbed because the micro-organisms are affected. Where the disturbance is too drastic as the result of injudicious cultivation, the soil's fertility must be reduced. Let us use the living soil to the greatest extent, but let us at the same time ensure that the use of the soil will be such that it remains a living soil, so that not only we ourselves but our descendants will have food.

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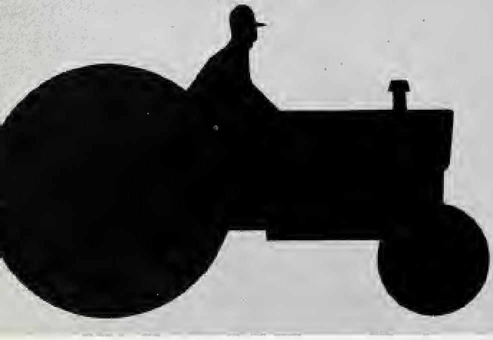

THE SOIL
OUR SECURITY

AGAINST STARVATION

SOME INTERESTING METHODS OF FRUIT AND SEED DISPERSAL IN TRANSVAAL PLANTS

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ILLUSTRATIONS BY R. COLLETT
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Because plants are unable to move about freely, it is necessary that the fruits and seeds they produce should be scattered as far as possible from the parent plant, so as to avoid crowding and the resultant competition.

Sometimes seeds are spread accidentally, as by summer floods which may carry them for long distances. By this means many weeds spread along riverbanks. Seeds of aquatic plants particularly may stick to mud on the feet of birds or other animals, while human activities such as road-building or transporting of fodder may spread seeds over great distances. A recent example is that of the Silverleaf Bitterapple, *Solanum elaeagnifolium,* a weed originally from the southern United States. This was first recorded in South Africa in the 1930's and has now invaded irrigated land in the Sundays River Valley near Graaff-Reinet to such an extent that valuable lucerne fields have been abandoned. Seeds of this weed were accidentally spread in lucerne which was sent as fodder to parts of the Orange Free State and south-western Transvaal, and the problem has now become extremely serious, especially in view of the fact that irrigated lands are on the increase as a result of the building of new large dams.

Regular methods of seed dispersal are by means of wind, water, animals and contraction or expansion of certain tissues of the plant. These methods will be discussed in what follows.

Dispersal by wind: This is the commonest method of dispersal, and plants are adapted to this in two ways, either by having fruits which open allowing the seeds to be shaken out by the wind, or the fruits or seeds themselves being blown away.

In plants in which the fruits open allowing the seeds to be blown away, we find that the seeds may be very small and light, so that the wind blows them away like dust. The seeds of Orchidaceae and of *Streptocarpus* are good examples of this. Sometimes the seeds are much larger, but flattened

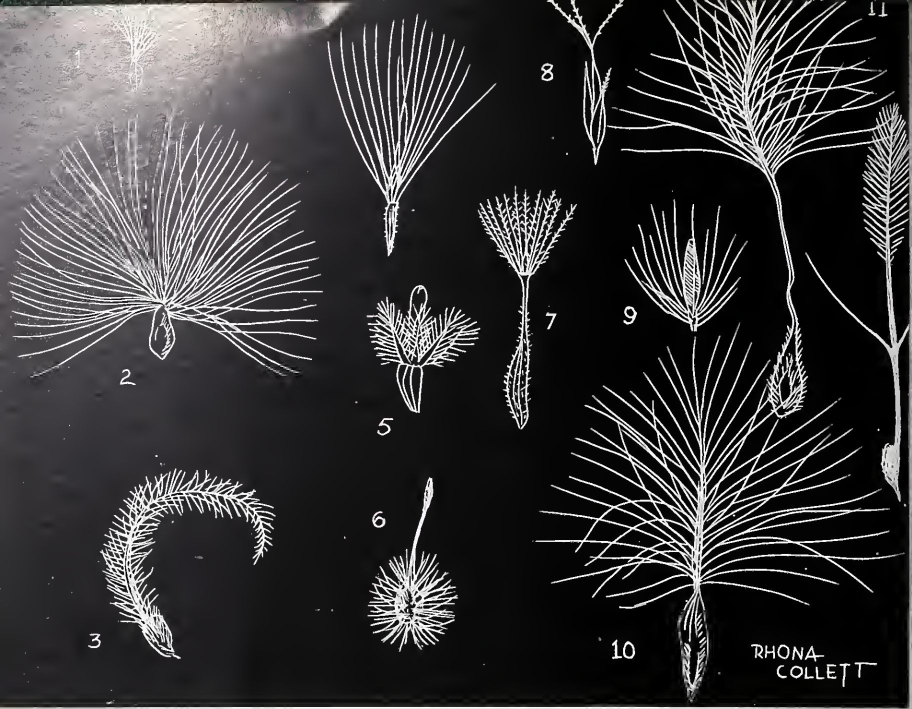

PLATE I
Fig.
1 *Conyza podocephala* (Oondbos) - fruit with pappus, x 3.
2 *Sarcostemma viminale* (Melktou) - seed with silky hairs, x 1.
3 *Clematopsis scabiosifolia* (Pluimbossie) - fruit with plumose style, x 1.
4 *Senecio longiflorus* (Sambokbossie) - fruit with pappus, x 1.
5 *Ursinia nana* - fruit with fimbriate pappus scales, x 2.
6 *Faurea saligna* (Boekenhout) - villous nut, x 2.
7 *Gerbera jamesonii* (Barberton Daisy) - beaked fruit with pappus, x 2.
8 *Aristida congesta* (Three-awn Grass) - grain with 3-partite awn, x 2.
9 *Phragmites communis* (Common Reed) - grain surrounded by silky hairs, x 2.
10 *Strophanthus speciosus* - seed with plumose awn, x 1.
11 *Strophanthus gerrardii* - seed with plumose awn with naked stalk, x 1.
12 *Stipagrostis obtusa* (Small Bushman Grass) - grain with 3-partite awn, central part plumose, x 2.

or provided with small wings to aid in their dispersal when they are shaken out of the fruit. *Markhamia acuminata* (Plate II, fig. 14) and *Sesamum alatum* (Plate II fig. 13) are examples of this method of dispersal. Other examples are found in the Liliaceae, Amaryllidaceae and Iridaceae.

The most common adaptation to dispersal by wind is the development of hairs on the fruits or seeds as illustrated on Plate I (except Fig. 8) and commonly found in the Transvaal.

Another adaptation to dispersal by wind is the development of wings on the fruit or seed, as illustrated on a part of Plate II (Figs. 5-14). Wings are also sometimes developed on parts of the flower other than the fruit or seed. In *Polygala* (Plate II Fig. 3) the two side sepals enlarge and form wings, while in *Dombeya* (Wild Pear) the petals are persistent. Sometimes the entire fruit becomes inflated and may be blown away, as in *Cardiospermum alatum* in which the seed is also attached to a wing-like septum. (Plate II Fig. 4). In some cases the entire inflorescence may be blown away. A well-known example is the fruiting umbel of *Boophane disticha* (Gifbol), which is often seen rolling across the veld in a strong wind, scattering seed as far as it goes (Plate III Fig. 10). In *Phragmites communis* (Common Reed) the whole inflorescence is also blown away.

Dispersal by water: Along our coasts seeds of tropical and subtropical plants are often found that have been transported hundreds of miles by sea current. The coco-nut is an example of a fruit that is adapted to dispersal by the sea. In the Transvaal some dispersal by water takes place in rivers or dams, and most aquatic plants have seeds which are specially adapted for this type of dispersal. In *Nymphaea* (Water-lily) for example, the seeds have small cavities filled with air, that help them to float away.

Dispersal by animals: Seeds dispersed by animals are either eaten or else carried away accidentally by sticking to the animal's body. Seed-eating birds are responsible for the dispersal of many plants, as for example of *Lantana camara,* that has recently been declared a noxious weed. Through the agency of birds, this plant is spread for miles. Another well-known example is the parasitic plant *Viscum* (Voëlent, Mistletoe); here the seed sticks to the beak of the bird and is then rubbed off on a branch where the bird next perches, and where it then germinates.

Some of the most interesting adaptations to dispersal are found in seeds or fruits which have developed hooks or spines, or a combination of these, to enable them to stick to the coats or feet of animals and so be carried over long distances. *Harpagophytum* (Grapple Plant) is a well-known example of this (Plate III. Fig. 11). To this group belong many weeds, some merely a nuisance but others of economic importance such as *Xanthium* (Boetebos) (Plate III Fig. 20) due to the harm it can cause to the wool industry. If these seeds or fruits that stick to clothing or animals' oats are examined under a lens, it will be seen that their tiny bristles are equipped with minute barbs which attach the seed or fruit firmly to the carrier. On Plate III examples of this will be seen, all very commonly found usually as weeds of cultivation.

Other seeds or fruits that are dispersed by animals are equipped with spines that stick into the paws of animals or the feet of humans. All of us have suffered from "dubbeltjies" (*Tribulus terrestris* and *Emex australis*) that have a practically identical shape, and from *Alternanthera* (Khaki Weed) (Plate III Fig. 8) that is widespread wherever humans have settled and covers the ground around abandoned Bantu huts. The fruits of *Alternanthera* stick to tyres of cars, to rubber shoe soles and even aeroplane tyres, and are so spread over huge distances. Another common thorn which is a nuisance especially in the northern Transvaal is *Dicerocaryum,* the "Boot Protector" (Plate III Fig. 6).

Dispersal by contraction or expansion of tissues: In a number of plants the seeds are dispersed by this method. In *Oxalis corniculata* (Creeping Sorrel), a common garden weed originally from America, the ripe capsule splits lengthwise along each of its five angles. The brown seeds are covered by a white outer integument that splits explosively at a touch or at a certain stage of drying, flinging the seed out to a distance of a couple of feet from the parent plant (Plate II Fig. 2). In *Monsonia* the persistent style in the ripe fruit curls up rapidly in a spiral carrying the seed with it. (Plate III Fig. 5). The same type of mechanism is found in many species of Leguminosae, where the pod on ripening suddenly splits and the two halves spiral outwards, scattering the seeds. (Plate III Fig. 1). The long awns of the grass *Heteropogon* (Spear Grass) are hygroscopic, causing them to twist spirally on coming into contact with moisture, so driving the seed into the ground. The same happens when they are brushed off into the wool of grazing sheep or other animals, and the sharp-pointed spikelet may penetrate the skin of the animal causing damage to the hide (Plate III Fig. 2).

In *Barleria macrostegia* that occurs mainly in the southern Transvaal, the ripe fruit is hygroscopic and opens explosively a few minutes after being moistened. The seeds, covered by dense hair that lies flat when dry but spreads out immediately on being moistened, are ejected and spread over a distance of several feet, where the hairs help to attach them to moist soil. (Plate II Fig. 1).

All the examples of fruit and seed with special methods of dispersal discussed above are easily found in the Transvaal veld or in gardens, and all seeds and fruits except those of protected plants may be gathered freely. Once seeds are collected they need to be treated with an insecticide, otherwise they would soon be destroyed by insects. An interesting collection, from which much can be learnt, can be built up in this way.

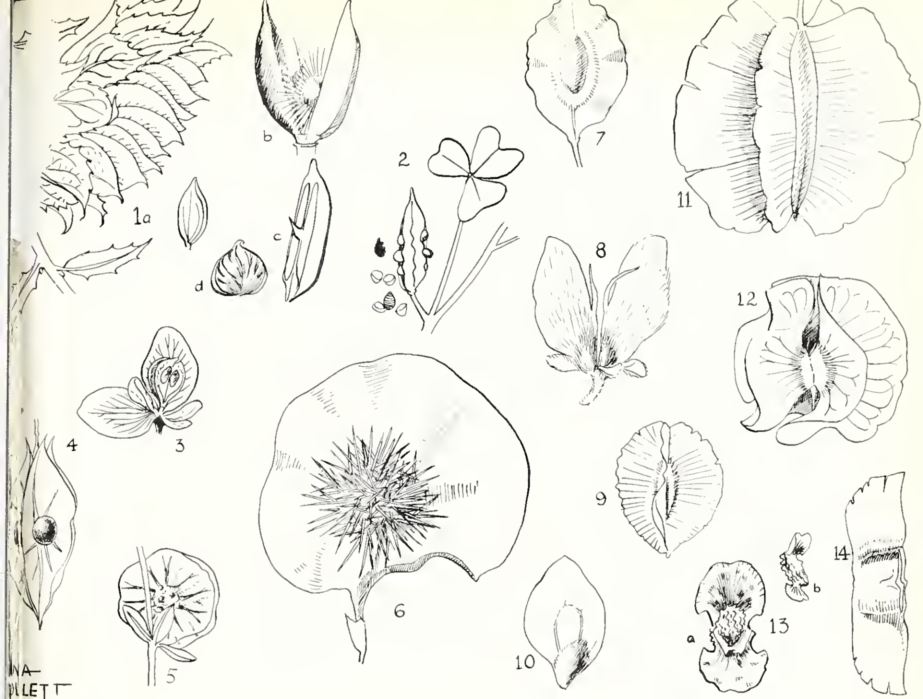

PLATE II

Fig.

1 *Barleria macrostegia*: (a) whole inflorescence with one fruit removed, x $\frac{1}{2}$; (b) fruit burst open after moistening, showing one seed with hairs expanded, x 1; (c) one half of fruit showing hook to which seed is attached, x 1; (d) dry seed, x 1.

2 *Oxalis corniculata* (Creeping Sorrel) - capsule split open showing seeds with membranous covering, x 1.

3 *Polygala virgata* (Bloukappie) - fruit with wing-like side sepals, x 2.

4 *Cardiospermum alatum* (Blaasklimop) - seed attached to wing-like septum, x $\frac{1}{2}$.

5 *Semonvillea fenestrata* (Wielbossie) - fruit with circular wing, x $1\frac{1}{2}$.

6 *Pterocarpus angolensis* (Transvaal Teak) - spiny fruit with large wing, x $\frac{1}{2}$.

7 *Terminalia sericea* (Transvaal Silver Tree) - winged fruit, x $\frac{1}{2}$.

8 *Sphedamnocarpus pruriens* - pair of winged mericarps, x 1.

9 *Tripteris aghillana* - fruit with 3 wings, x 1.

10 *Schrebera argyrotricha* - seed with wing, x 1.

11 *Combretum zeyheri* (Raasblaar) - 4-winged fruit, x $\frac{1}{2}$.

12 *Triaspis nelsoni* (Klapperbossie) - fruit with winged carpels, x $\frac{1}{2}$.

13 *Sesamum alatum*: (a) seed with 2 wings, front view x 3; (b) side view of seed, x $1\frac{1}{2}$.

14 *Markhamia acuminata* - seed with papery wings, x 1.

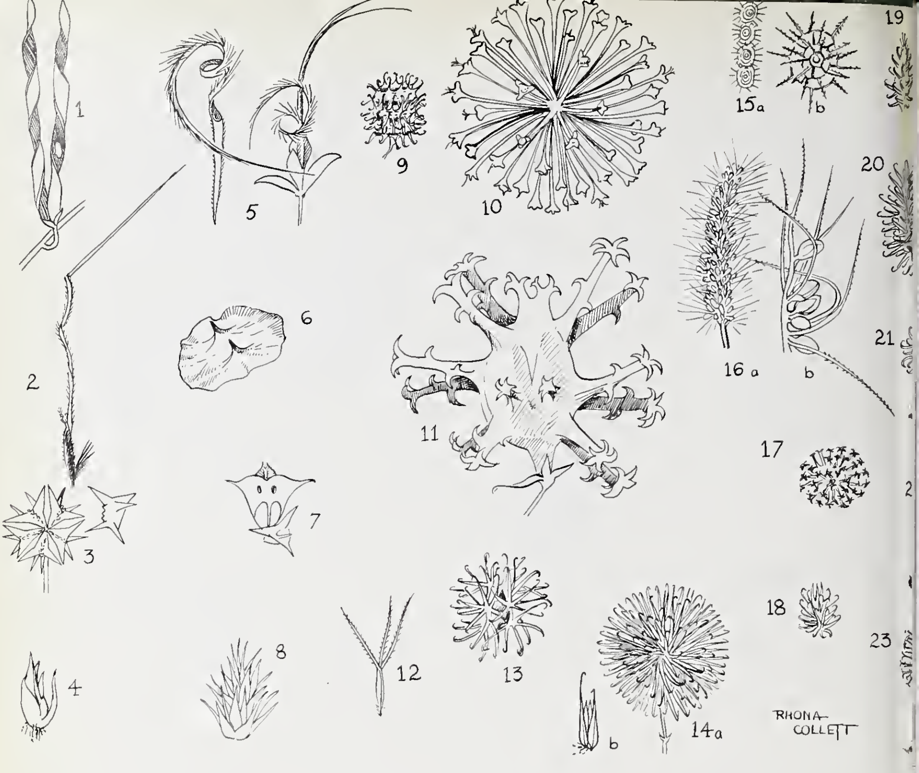

PLATE III

Fig.

1 *Teramnus labialis* - pod split open and twisted spirally, x ½.

2 *Heteropogon contortus* (Spear Grass) - sharp-pointed grain with spirally twisted awn, x ½.

3 *Tribulus terrestris* (Dubbeltjie) - whole spiny fruit and one carpel split off, x 1.

4 *Achyranthes aspera* (Rough Chaff Flower) - fruit enveloped in spiky perianth, x 1.

5 *Monsonia burkeana* - mericarp with spirally twisting style, x 1.

6 *Dicerocaryum zanguebarium* (Boot Protector) - fruit with 2 sharp spines, x 1.

7 *Emex australis* (Emex-dubbeltjie) - fruit with 3 spines, x 1.

8 *Alternanthera pungens* (Khaki Weed) - fruits enclosed in papery bracts and perianth segments. x 1.

9 *Medicago aschersoniana* (Bur Clover) - spiral pod covered with hooks, x 1.

10 *Boophane disticha* (Gifbol) - whole inflorescence, x 1/16.

11 *Harpagophytum procumbens* (Grapple Plant) - fruit with grapple-shaped hooks, x ½.

12 *Aristida bipartita* (Three-awn Grass) - grain with awns, x 1.

13 *Pupalia lappacea* - fruit enclosed in bracts covered with hooked spines, x 1.

14 *Cyathula uncinulata* (Globe Cyathula) : (a) whole inflorescence, x ½; (b) one fruit showing hooked perianth-segments, x 1.

15 *Zornia diphylla*: (a) pod, x 1; (b) one segment of pod, showing small barbs, x 3.

16 *Setaria verticillata* (Bristle-grass): (a) whole inflorescence, x 1; (b) portion of inflorescence showing barbed awns, x 2½.

17 *Cynoglossum enerve* (Hound's Tongue) - glochidiate nutlet, x 1.

18 *Sanicula elata* - fruit covered with hooked spines, x 2.

19 *Tragus berteronianus* (Carrotseed Grass) - grain covered with hooked spines, x 3.

20 *Xanthium strumarium* (Cockle Bur) - fruit with hooked spines, x ½.

21 *Acanthospermum glabratum* (Prostrate Starbur) - fruit with hooked spines, x 1.

22 *Bidens bipinnata* (Blackjack) - achene with barbed awns, x 1.

23 *Lappula echinata* (European Stickseed) - glochidiate nutlet, x 2.

THE YELLOW WATER-LILY OF THE VAAL RIVER

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Shortly after my article on the South African Water-lilies appeared in Fauna & Flora, No. 18 (1967), my attention was drawn to a yellow *Nymphaea* which had established itself along the banks of the Vaal River between Langdon Bridge and the Barrage, viz. around Vanderbijl Park. The plant represents a hardy hybrid of *Nymphaea mexicana,* that must have escaped from a garden-pond and has since spread rapidly on both sides of the river, forming dense interrupted fringes for several miles. They have penetrated to a depth of about 10 feet which is believed to be their maximum depth.

The very attractive fragrant yellow flowers are exserted above the water. The petals are pointed and erect. The rounded leaves, that are up to 25 cm in diam., curve upwards along the wavy margin. The lower surface of the leaf is wine coloured but not blotched. In the midst of one community a somewhat different cultivar with larger paler flowers was observed.

These beautiful Marliac hybrids of the *Castalia* section are the product of crossings made by a French nurseryman, Mr. Latour-Marliac, between 1885-1890. The first members of this series were yellow flowered and had an American ancestor, *N. mexicana* (also called *N. flava* by some taxonomists).

In the shallow creeks on the northern bank gardeners have planted another Marliac hybrid with the common European *Nymphaea alba* as an ancestor, and perhaps also *N. odorata.* This water-lily is the one commonly cultivated in parks and gardens all over South Africa. The flower rests on the surface of the water and the spreading and curved petals are more rounded above; they vary in colour from white to pale yellow to pink and dark red. The leaves are green, unspotted and have a smooth margin. Nurserymen refer to it as *Nymphaea* x *marliacea.* Up to the present it seems to have remained confined to the garden creeks.

In the stretch of dammed up water below the Vaal Dam and above the Barrage the flow and water-level are more or less controlled, providing the aquatics with favourable growing conditions. At present these lovely water-lilies certainly add charm to the banks of the Vaal River and do not seem to interfere with the flow of the water or impede traffic or sport.

ARTIFICIAL STOCKING OF DAMS IN TROUT MANAGEMENT

P. LE ROUX

For several years there has been a trend in the Transvaal to promote the sport of trout fishing in dams. These waters have proved to be more stable and consistent producers of fish than streams, if the primary requirements of trout are satisfied. Transvaal streams are relatively small and riparian owners show little interest in developing their potential. Coupled with poor land-use practices, this has made them less important as trout waters than in former times.

In order to gain some information on the success of trout populations in impoundments, data have been gathered from several sources over the past few years and analysed to provide some indication of the growth rate, survival, production, angling pattern and sex ratio of the fish in farm dams. This was done by seeking the co-operation of dam-owners in supplying data on the catches from their dams, as well as keeping records of the stockings and supplying them with marked fish. The history of one dam in particular, that of Longmeadow Home Farm owned by the company of the same name, has been followed since the time it was built and provides a comprehensive record of fishing from a farm dam over a period of sixteen seasons. The owners have even allowed experimental stockings of fish to be carried out, and their willingness and help are gratefully acknowledged. Most of the data here discussed are from this dam.

DESCRIPTION OF THE STUDY AREA

Longmeadow Home Farm is situated just outside the village of Dullstroom at an altitude of over 6,500 feet above sea-level. The dam has been built in a small tributary just before it enters the Crocodile River, and has a surface area of slightly more than 5 acres. There is a small inflow of water, but as no suitable spawning sites for trout are present in the incoming streams, the dam is dependent on continual restocking for maintaining a trout population. It has a moderate amount of weeds in the shallower areas making it very difficult to net, a procedure which was only attempted once with meagre results.

Much of the plateau of the Steenkampsberg in the area between Belfast and Dullstroom lends itself to the construction of dams, in which trout thrive as the area is over 5,000 feet in altitude; well-watered and marshy areas and vleis abound. As a result many dams have been constructed in the area during the past few years and it has acquired a reputation for trout fishing. Many of the dams in the area are of considerable size, from 10 to 50 acres in surface area.

STOCKING HISTORY

Although a few brown trout (*Salmo trutta*) were occasionally used in stocking the dam, their number was very small and the returns insignificant. Table 1 records the stocking of rainbow trout (*Salmo gairdneri*), and all further references in this paper will be to this species only.

RECOVERY OF FISH

Table 2 gives an analysis of the size of all fish caught from the dam in the various seasons. Prior to 1959 the weights and condition factors only were recorded, and it has been possible to determine the length of the fish caught by back-calculating from the tables of the condition factor used by the anglers. From 1959 onwards the length and weight of every fish caught have been recorded.

Recoveries of the marked fish placed in the dam since 1958 are tabulated in table 3 in the various age groups. It is obvious that most of the fish

Table 1 Stocking history, Longmeadow Home Farm Dam.
Rainbow Trout, 1950 - 1965

TIME	NUMBER	SIZE
September 1950	80	Fingerlings
August 1951	250	Fingerlings
October 1952	250	Fingerlings
December 1953	300	Fingerlings
October 1954	400	Fingerlings
October 1955	600	Fingerlings
August 1956	50	Fingerlings
October 1958	600	Fingerlings
May 1959	300	6 - 8-inch fish
June 1961	300	6 - 8-inch fish
March 1962	300	6 - 8-inch fish
May 1963	300	6 - 8-inch fish
May 1964	300	6 - 8-inch fish
May 1965	300	6 - 8-inch fish
December 1965	1500	Fingerlings

(No stocking was done in 1957 and 1960)

Table 2 Angling results of Rainbow Trout from Longmeadow Home Farm Dam, 1951 to 1967

SEASON	LENGTH OF FISH IN INCHES															
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	TOTAL
1951/52	1	4	1	2		2	2	6	4		2	1					25
1952/53		1	1	1	7	11	9	4	4		1	2	1				42
1953/54				3	1	4	4	8	3	4	2	1					30
1954/55			2		4	4	3		2	3	1	3	1	2			25
1955 56							2	5	4	2	2	1	3	3			22
1956/57		1	1	5	22	22	10		1			1	2	1		1	67
1957/58						3	1	5	10	3	2			1			25
1959/60			2	24	49	15	6	1	1		1	3	3				105
1960/61						2		7	7	6	3	1	1		1		28
1961 62		2	2	3	16	51	41	25	5	3	2	4		2			156
1962 63			6	17	50	40	17	7	7	3	3	1	2				153
1963/64		1		6	33	72	67	28	11	8	2	2		1			231
1964 65			2	11	22	16	10	4	5	8	4	2	2				86
1965 66			2	8	30	59	25	15	1	1	2	3	2			2	150
1966 67					6	10	16	9	10	8	6	1			1	1	68

(In addition, 7 Brown Trout were taken from the dam)

3 -4- 1969

stocked were caught in the first angling season after release. Expressed as percentages 89.5 per cent of the total recoveries comprised fish one to two years old (I+), 9 per cent were recovered as two-year olds, while older fish were only 2.5 per cent of the total catch. Of the total number of fish stocked in the period, only 24 per cent were recovered.

It is obvious from table 3 that there is a great variation in the recoveries from different stockings. With a few exceptions these differences are correlated with the size of the fish used for stocking. Recoveries in the period during which marked fish were used gave an average return of 6.6% for fingerling stockings, whereas 44.4% of the yearling stockings were caught. The latter figure would be considerably higher if the poor return from the 1964 stocking could be ignored. This was due to two distinct mortalities during which several dead fish were noticed by the manager. These occurred in the winter of 1964, shortly after stocking, and in the summer of 1964/65 during the season in which the fish would normally have been available to anglers.

Although it was not possible to assess the success of earlier stockings accurately, comparison of tables 1 and 2 would indicate a return of less than 10 per cent for the period 1950 to 1958. Taking all results obtained from the dam into consideration, it would seem as if restocking with sub-

Table 3 Angling recoveries from stockings with marked fish. Longmeadow Home Farm Dam, 1958 - 1966

DATE STOCKED	FISH RECOVERED AT AGES				TOTAL	% OF STOCKING
	I+	II+	III+	IV+		
1958	69	13	3	NIL	85	14.2
1959	22	9	8	NIL	39	13.0
1961	145	16	4	NIL	165	55.0
1962	136	20	2	NIL	158	52.0
1963	205	13	2	1	221	73.7
1964	69	3	1	NR	73	24.3
1965 (a)	141	2	NR	NR	143	47.7
1965 (b)	53	NR	NR	NR	53	3.5

NR = No record available.

Table 4 Weight of fish cropped by angling from Longmeadow Home Farm Dam, 1951 to 1967

SEASON	TOTAL WEIGHT	WEIGHT PER ACRE (LBS)
1951/52	30 lbs 11 oz	6.1
1952/53	49 lbs 3 oz	9.8
1953/54	42 lbs 7 oz	8.5
1954/55	41 lbs 6 oz	8.3
1955/56	49 lbs 13 oz	10.0
1956/57	65 lbs	13.0
1957/58	41 lbs	8.2
1959/60	95 lbs 9 oz	19.1
1960/61	49 lbs 5 oz	9.9
1961/62	172 lbs 5 oz	34.5
1962/63	130 lbs 14 oz	26.2
1963/64	226 lbs 9 oz	45.3
1964/65	98 lbs 9 oz	19.7
1965/66	143 lbs 1 oz	28.6
1966/67	99 lbs 10 oz	19.9
Total	1,335 lbs 6 oz	

No fishing was done in 1958/59 season

yearling fish of six to eight inches in length is from five to eight times more effective than using fingerlings.

The total weights of fish cropped from the dam in the different seasons are tabulated in table 4. To arrive at a realistic figure as a guide in the management of trout in dams, it would be patently unfair to consider the average over the whole period. At the beginning of the period, the numbers of fish were obviously too small in relation to the carrying capacity of the water. No record was kept of the fishing effort expended,

marie laubscher

but this certainly fluctuated considerably. As the number of fish caught would depend on the fishing pressure to some extent. the only conclusion to be reached from the available evidence is that the yield by angling may be as high as 45 pounds per acre in a dam such as Longmeadow; under extreme fishing pressure it may be even higher.

GROWTH AND SURVIVAL OF TROUT

As indicated in figure 1, many fish are over ten inches in length at the beginning of the angling season in October of every year. Considering that they were stocked at a length of about six inches in May of the same year, the rate of growth approaches one inch per month. It is also clear from the figure that the growth rate slows down during the summer, and

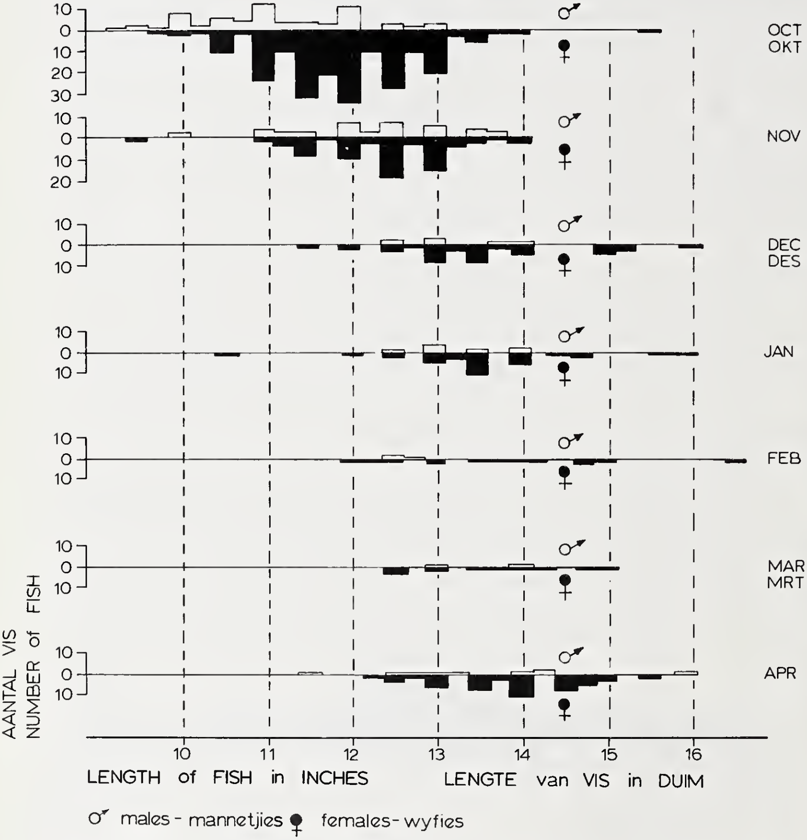


Fig. 1 *Length distribution of yearling catches grouped by months and sexes. Longmeadow Home Farm Dam, 1962 to 1967*

Table 5 Sex ratio of rod-caught fish, Longmeadow Home Farm Dam, 1962 - 1967

	AGE OF FISH			
	I+		OLDER FISH	
	MALES TO FEMALES		MALES TO FEMALES	
MONTH				
Oct.	1	3.7	1	3.5
Nov.	1	3.1	1	1.3
Dec.	1	6.8	1	2
Jan.	1	4.9	1	1
Feb.	1	4	1	3
Mar.	1	6.5	1	5
Apr.	1	3.7	1	3
All fish	1	3.8	1	2.2

only the odd fish reaches a length of more than 15 inches in its second year of life.

This is the case in the Longmeadow Dam, where stocking has latterly been sufficient to make full use of the carrying capacity of the water. While some fantastic growth rates have been obtained in fertile understocked waters, the rate of growth recorded in the Longmeadow Dam has also been observed in many other waters in the Transvaal.

In a stream where the fish were fed throughout the year, Brewer (personal communication) obtained remarkable results, producing fish of more than three pounds before the end of their second year. This seems to indicate a shortage of food organisms in the water during summer, possibly as a result of the rains. Although water temperatures in summer sometimes approach the upper tolerance limit for trout, no direct evidence of any detrimental effect of such temperatures has been obtained. From figure 1 it would appear that male trout grow slightly slower than female fish; many males are noticeably smaller at the beginning of the season. Although data are scanty, it would appear that males make up for this in the summer and at the end of the season there is little length differentiation between the sexes.

A trend which is well known to fishermen in Transvaal is also indicated in figure 1, but more clearly expressed in table 5. Male fish are usually very much fewer in number than females, and no simple explanation can be given for the phenomenon. Few pertinent data are available, but the ratio of 3 or more females to 1 male in anglers' catches is a regular feature of trout fishing, even when only yearlings are considered. As regards the mortality of trout, it is obvious from the results given in the tables and figures that a heavy mortality occurs at some stage during the lifetime of the fish. Stocking with larger fish of six to eight inches in size brings a greater return, but at best some 30 to 60 per cent of stocked fish are lost. The fact that great fluctuations in the number of fish caught during their first year of life do not greatly influence the number of fish caught at greater ages (table 3) would indicate that this mortality occurs

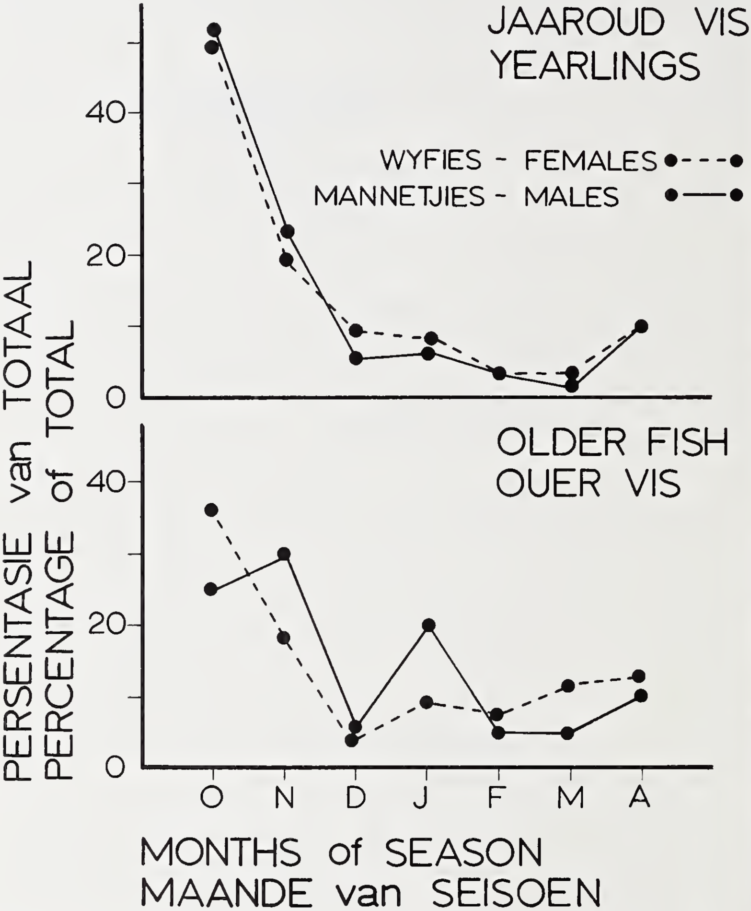


Fig. 2 *Distribution of anglers' catches during the trout season. Longmeadow Home Farm Dam, 1962 to 1967*

throughout the lifetime of the fish. Fish not cropped during the season when they first become available are to a large extent lost to the angler. It is not possible to arrive at any proper estimate of mortality rate in the absence of data on fishing intensity. No fish older than five years have ever come to hand in the present study, and only an occasional fish has exceeded three years in age.

SEASONAL CATCH PATTERN

The whole of the trout area of the Transvaal is subject to a summer rainfall season which influences the catch pattern profoundly. Most of the fishing usually takes place during the first two months of the season and the last month (figure 2).

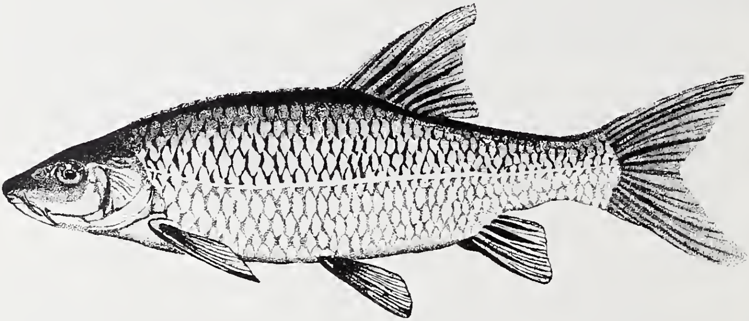
This holds good for rivers as well as impoundments and is probably not the result of a diminished supply of fish, but rather the result of a combination of higher temperatures and turbid water, and consequently more difficult fishing conditions. There is no evidence that larger fish are more difficult to catch than smaller fish, or that conditions at certain times of the season are especially conducive to taking fish of a certain size or age.

CONCLUSION

Trout thrive in cold impoundments, and artificial stocking gives good results provided the fishing is heavy enough to crop the available fish. Natural mortality is fairly high and present results indicate that stocking rates of 60 to 100 yearling fish per acre in unfertilized dams may be expected to give an angling yield from 20 to 40 pounds per acre annually. A higher return could probably be attained if the fishing in summer were more efficient. Continual restocking on an annual basis is unavoidable if the fishing is to be maintained.

ARTIFICIAL CULTURE OF THE VAAL RIVER YELLOWFISH (BARBUS HOLUBI)

P. LE ROUX



marie laubscher

The Vaal River Yellowfish or Smallmouth Yellowfish, as it is more commonly known, is one of the most popular sporting fishes of the Province. After the establishment of the Nature Conservation Branch, one of the first objectives was to propagate this species artificially, so that young fish would be available for distribution in waters from which it was absent, or for restocking waters in which the natural populations had been reduced for some reason or other.

Although yellowfish had been kept in the ponds of the Fisheries Institute since 1950, the initial progress in artificial culture was slow, because very little was known of the requirements of this fish. A few fish were produced annually, but it was clear that with the correct technique a much larger production could be achieved.

Since 1960 the breeding of this fish was carefully studied, with the result that the culture of yellowfish was placed on a sound basis; so much so, that repopulation of a depleted section of the Vaal River was possible in 1963.

In the early years of observation of the fish's spawning habits, it was found that spawning started as soon as spring water temperatures exceeded 65 degrees Fahrenheit, and that the fish deposited the ova in nests excavated in gravel-beds. (Groenewald, 1951). In this process the tail fin was used to remove fine particles and debris with a sweeping motion, and the completed nest was roughly 12 to 18 inches in diameter and slightly concave. It was also found that the yellowfish can spawn throughout the summer, and fry were noticed as late as March.

Some fry were produced during the first year in which fish were kept, but when the numbers of eggs present in the ovaries were compared with the numbers of fish produced in a dam, it was obvious that a very significant loss was being sustained somewhere. The ovaries of a single large female may contain 20,000 eggs or more. When the breeding season of 1960/61 was again very disappointing, it was decided that the fish's breeding habits should be studied in detail.

In that year it was discovered for the first time that most of the eggs in a nest suffocated as a result of the lack of oxygenated water; this was due to the fact that water did not circulate through the gravel of the nest. The solution was to construct gravel-beds for nest-making in such a manner as to allow water to flow through the gravel. The natural spawning

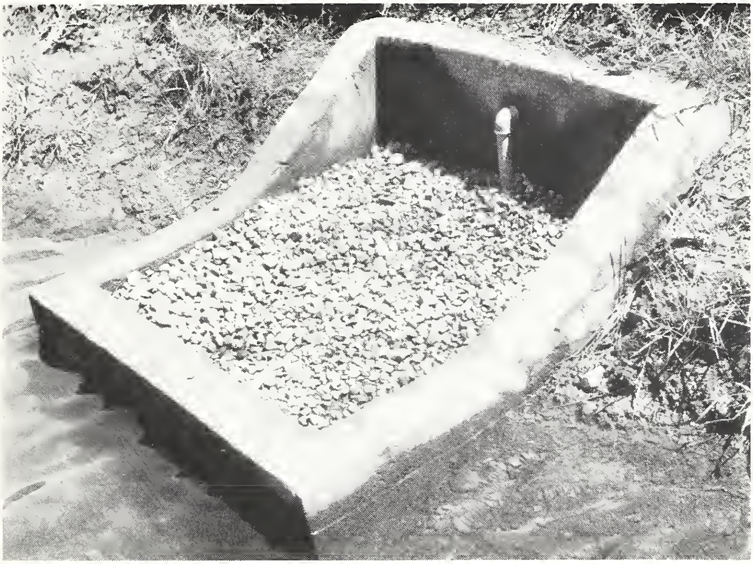


Fig. 1 A *Gravel spawning-bed for the culture of* Barbus holubi, *Provincial Fisheries Institute, Lydenburg*

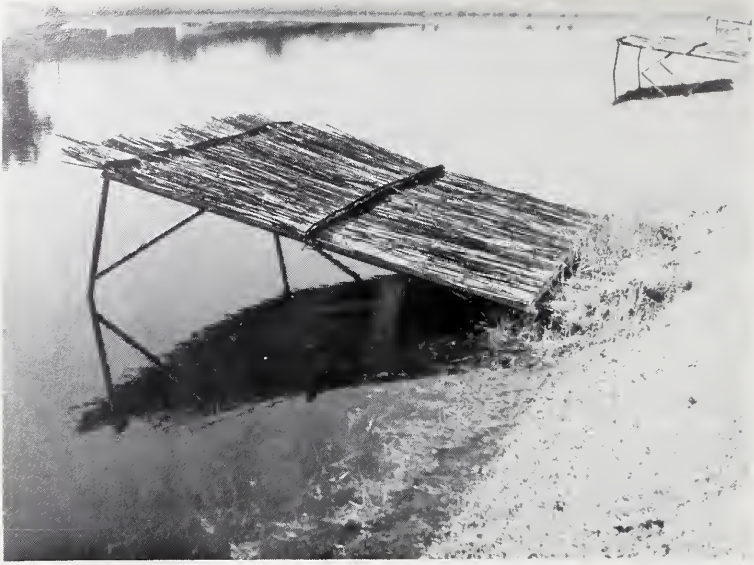


Fig. 2 *Shelters are placed over the beds for shade and protection against disturbance*

sites of these fish, viz. gravel at the lower ends of pools, provide such a flow of water through the substratum.

Several experiments had to be made to find the most suitable shape and position of these beds to ensure that the flow of water was strong enough to aerate the eggs, but not so strong as to prevent the newly-hatched fry from emerging from the gravel. The beds currently being used are illustrated in figures 1 and 2, while the sketch in figure 3 gives full constructional details. The roofs over the nesting boxes provide shade and also screen the timid fish from disturbances on the dam-wall, such as people moving about.

The gravel in the beds is completely removed before the breeding season and thoroughly washed to remove all traces of silt. The concrete box is cleaned and all the pipes and stopcocks cleared to ensure a free flow of water.

It is important to have a constant flow of water through the beds, as ova may suffocate from lack of oxygen if the water-supply is interrupted. The water supply to the dam itself should also be constant, as a drop in water-level will expose and dry out the nesting gravel. It is not yet known

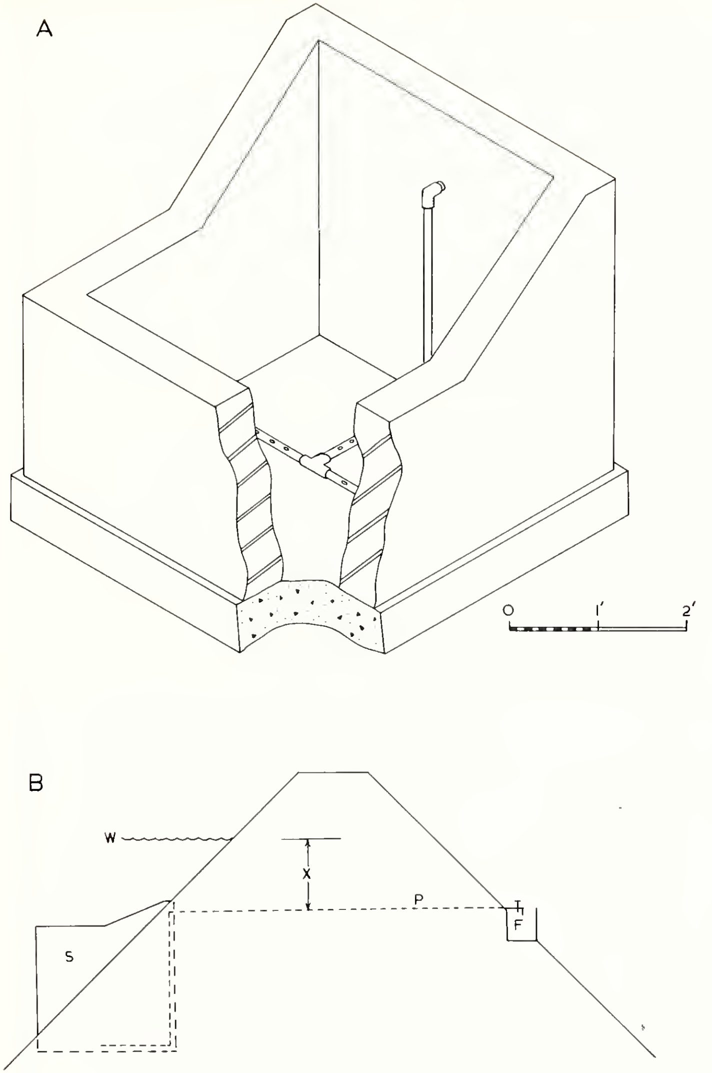


Fig. 3 *A. Construction of the spawning-bed. It is filled with stone* 1 *to* 2 *inches in diameter. B. Schematic section through the dam-wall to show the position of the bed. P is the pipe-line draining water from the spawning-bed S through a stopcock into the furrow F. The distance X, between the water-level of the dam W and the pipe-line, should not be less than* 12 *inches*

whether yellowfish spawn a second time if for some reason the first spawning is lost, but it is thought that parent fish do not lay all their eggs at one spawning.

At present four nesting boxes are provided along one wall of a quarter-acre pond, but it is possible that more boxes will be more efficient. A quarter-acre pond is stocked with ten males and twelve to fifteen females. Stocking is carried out in September before water temperatures rise. At this time external sexual characters are obvious and the fish can be sexed with some certainty. Females are usually heavier and softer in the abdominal region than males as a result of the size of the ovaries. The rays of the anal fin of the male have prominent tubercles which can be felt if the fin is drawn between the fingers. In many cases the males are ripe enough for exuding milt that may be seen when slight pressure is exerted on the abdomen.

It was found that the Clawed Toad (*Xenopus laevis*) eats eggs of species such as yellowfish that do not guard the nests, and it was necessary to keep these animals from the breeding ponds. Fortunately this turned out to be comparatively easy, as the toads are not attracted to unfertilized ponds. The latter have very little food for the toads or fry of yellowfish, so that it was only necessary to leave the breeding ponds unfertilized to keep out the toads. This made it necessary to remove the fry at an early stage to ponds which had been fertilized and in which an ample food supply of small aquatic organisms was present.

MATING AND EGG LAYING

Although brood fish were seen over the beds quite frequently, the actual mating and laying of eggs were never observed. Examination of the beds at various times indicated that the eggs were in a very early stage of development in the morning, which indicated that mating and the deposit of eggs occurred during the night or very early morning. As any disturbance such as a light would cause immediate cessation of activity, it has so far not been possible to observe the actual process.

The eggs are deposited in a hollow in the gravel and then covered with the available material. Eggs have been found under six inches of gravel. In the beds presently used it is not unusual to find fry moving downstream, through the gravel to the outlet of the pipe behind the dam-wall. It is possible that in nature the fish are more particular in choosing a breeding place, where there is no possibility of the fry being carried away by the current through the gravel. It is also possible that in natural gravel beds there is a more horizontal flow of water which would allow the small newly-hatched fish to move along with it and so escape from the surrounding gravel.

Where space is limited, it frequently happens that nests are built on top of one another with the result that the eggs of the lower nest are destroyed. As a rule several fish are seen on the bed at the same time, but it is still not known if all these fish take part in the spawning act. It has not been possible to breed separate pairs held in small ponds and it may be that, as with other members of the family, more than one male serves for every female, and that there is thus no paired mating.

DESCRIPTION OF THE EGGS

Fertilized eggs were kept in an aquarium in order to study the further development. They are spheroid or slightly ellipsoid in outline with a diameter slightly more than three millimeters. The eggs are transparent and slightly pinkish which makes them very difficult to distinguish from the surrounding gravel (figure 4). Dead eggs are white as a result of the coagulation of the contents.

DEVELOPMENT OF THE EMBRYO AND FRY

Development of the fertilized egg is relatively fast and within two days the embryo can be seen moving about in the ovum. At this stage it is only an elongated mass of cells without any colour, but with the aid of a microscope the beginnings of the different body parts can be distinguished.

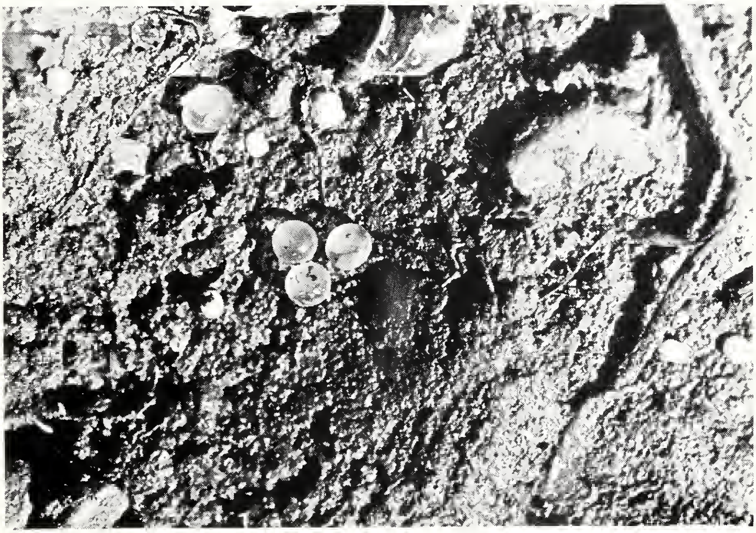


Fig. 4 *Eggs of* Barbus holubi *in an opened nest. The small white eggs are unfertilized and dead. (Magnified)*

By the third day the embryo is a clearly-formed fish with a beating heart and poorly-developed fins. After four days, immediately before hatching, the little fish is still very imperfectly developed. No mouth can be seen and the gills are still undeveloped, while the body has no pigment. The embryo is now about 8.5 millimeters long.

For some time after hatching, the young fish cannot lead an independent existence and until such time as the mouth is fully developed, it has to live on the contents of the yolk-sac still attached to the abdomen (figure 5). Three to five days after hatching ,the young fish starts to swim about actively. It is then about ten millimeters long and quite colourless, so that it looks like a splinter of glass. At the age of two weeks the fry move into the shallows, where they form little schools among the emergent weeds. They are now caught with a fine net and transferred to ponds in which the food supply has been built up especially for them. As additional food, finely minced liver may be given and they soon learn to take it.

After four to six months the young fish are from three to four inches long and may be placed in natural waters. Although they are rather delicate, they may be transported by rail over considerable distances in plastic containers half-filled with water, in which the air over the water has been replaced by oxygen. About 50 fish of two to three inches may be transported thus in a five gallon container.

If the fish are carefully handled, their survival is excellent. In one particular case (Le Roux, 1963) it was found that at least 75% of the original fish survived after twelve years in a dam; during this time they attained a weight of four to eight pounds each. If the fish are introduced into fertile waters, in which the food-supply is sufficient, they may be ready for use after two years.

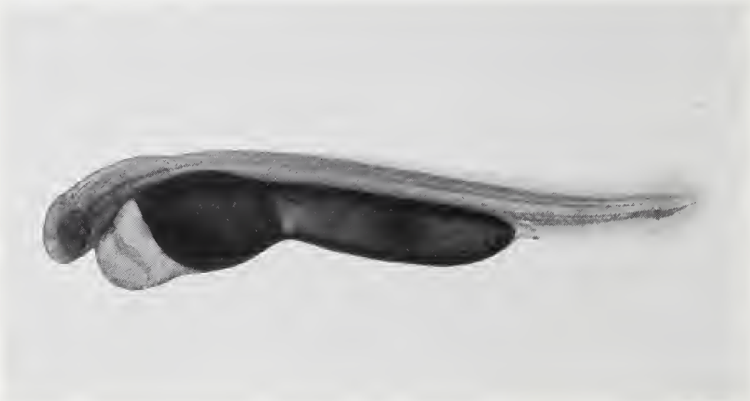


Fig. 5 *A newly-hatched* Barbus holubi. (*Magnified*)

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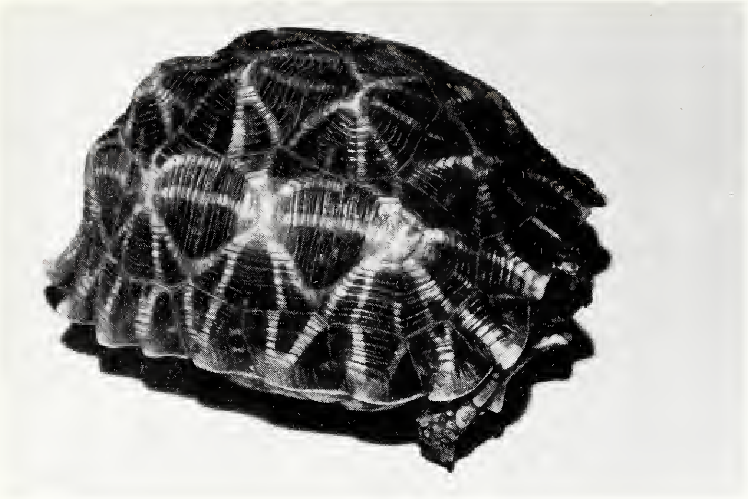
HIBERNATION OF THE KALAHARI GEOMETRID TORTOISE AND OTHER SPECIES IN THE TRANSVAAL

P. LE S. MILSTEIN
Barberspan Nature Reserve

Several specimens of the handsome Kalahari Geometrid Tortoise (*Psammobates oculifera*) were recently discovered on the farm Amsterdam 116 (23°17'S, 29°24'E) in the Soutpansberg district. Rather surprisingly, these records, dating from March, 1966, may be only the third authentic ones of the natural occurrence of this species in the Transvaal, according to Mr. W. D. Haacke, Herpetologist at the Transvaal Museum. However, of the three tortoise and one terrapin species now recorded from this locality, the Kalahari Geometrid Tortoise has been encountered most frequently. The habitat is the Arid Sweet Bushveld of Acocks (1953), showing a great deal of affinity, both floral and faunal, with the Kalahari.

Two Kalahari Geometrid Tortoises were recorded hibernating 22 feet apart in mid-May, 1966. They were approximately one third to half buried in the soft red sand, under the scanty shelter of fallen *Acacia tortilis* branches. The cavities had apparently been dug by themselves. So as not to affect their hibernation, the tortoises were not interfered with at all, not even to take weights and measurements, but were kept under regular observation. The smaller tortoise was about 3½ inches long, and the larger one about 4½ inches in length.

The tortoises remained apparently comatose without any change of position. However, on the 3rd July, 1966, it was found that the smaller tortoise had for some unknown reason moved 28 feet away from its original position near the other tortoise. Clear tortoise spoor showed that it had travelled a nearly direct route. The new position was again under the nominal protection of fallen acacia branches. Although the new site was more exposed, the tortoise did not partially bury itself as before, but remained on the surface of the sand. Although the area was undergoing what is reputed to be the worst drought in recorded history, it is not considered that this had any significant bearing on the degree of concealment of the tortoises. The reason was that the upper layer of sand was relatively soft and easily shifted.



The Kalahari Geometrid Tortoise Photo: W. D. Haacke

On the 23rd of September the smaller tortoise had ceased hibernation and moved off. The larger tortoise remained longer, but had also moved off by the 30th of September. This indicates a hibernation period of not less than 4½ months, dependent on how soon after the commencement of hibernation the tortoises had been discovered.

The larger tortoise was clearly individually identifiable by severely injured post-central and marginal epidermal plates, resembling fire-scarring. The more brightly-marked smaller tortoise could not be identified with equal certainty. Unfortunately it was the smaller tortoise that possibly made an unexpected return visit to the hibernation site. This indicates the possibility of an unsuspected site attachment. A tortoise was noted on the 7th November, 1966, sleeping in precisely the same slight hollow as that in which the smaller tortoise had passed the first period of its hibernation. This tortoise appeared identical to the smaller one, and its choice of exactly the same position to a fraction of an inch makes this likely in my opinion. By the 9th November the tortoise had moved off again.

Several Leopard Tortoises (*Geochelone pardalis*) were also encountered at the same locality. One of this species was noted hibernating on 28th July, and last recorded on 30th August, 1966. The site chosen was more concealed than that of *Psammobates,* being half-buried in the shelter of a small densely-branched shrub. The only specimen of the Hinged Tortoise (*Kinyxis belliana*) observed on the Amsterdam locality was recorded by my colleague, Mr. M. F. Johannsmeier, in early December, 1966, and was consequently not hibernating.

Unlike the tortoises, which appear to be temperature-dependent, the Common Water-tortoise or Terrapin (*Pelomedusa subrufa*) was not observed to emerge from hibernation until after the first rains had fallen. Due to the severe drought, the Hout River adjoining the farm had ceased flowing. Even deep pools, that were reputed to have retained water in all previous droughts, had dried up entirely. Soon after the first reasonable rains occurred (table), the terrapins appeared. On the 15th November, 1966, six adult specimens of the Common Terrapin were found in a shallow rain-water pool in a small hollow on an enormous boulder. This outcrop was about 2,000 yards east of the Hout River. No other macroscopic animals nor any vegetation were as yet present in this pool. Four terrapins still remained on 17th November, but all had left by the 24th November, presumably in search of more favourable conditions. Subsequently, in early December, Johannsmeier found a terrapin about 900 yards NNE of this rock pool in another pool that had been completely dry. This may have been one of the original six terrapins in view of the decidedly limited water habitat available. He also observed spoor indicating that these terrapins were still moving around.

Table: *Post-drought rainfall (mm) on the farm Amsterdam* 116

Date	30.9.66	14.10.66	22.10.66	8.11.66	9.11.66	18.11.66	19.11.66	30.11.66	Total
Amount	1.2	1.8	4.3	16.0	2.5	8.0	14.1	0.7	48.6

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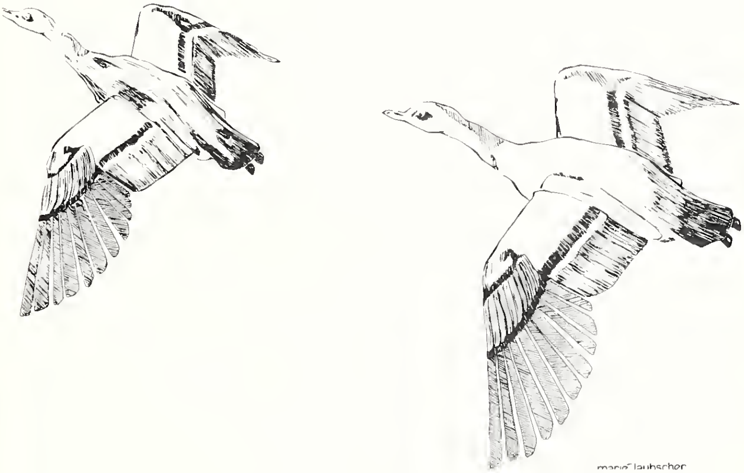
PRACTICAL CENSUS METHODS FOR WATERFOWL CONSERVATION IN THE TRANSVAAL

P. LE S. MILSTEIN
Barberspan Nature Reserve



Effective methods of censussing waterfowl are particularly important in South Africa. Unlike Britain and the United States, where the bulk of the waterfowl are non-breeding migrants, most of our waterfowl are comparatively sedentary and consequently more vulnerable. Breeding stocks must be maintained at a level sufficiently high to guarantee perpetuation of the species, the ideal of nature conservation, by producing an annual surplus which hunters can crop. Although some of our species like the Redbill Teal (*Anas erythrorhyncha*) and Southern Pochard (*Netta erythrophthalma*) are capable of considerable movements, local movements in search of suitable feeding grounds are generally undertaken.

Waterfowl management is in its infancy in South Africa, but the awakening interest must receive timely attention. In the Transvaal and other parts of South Africa, the great expansive phase of conservationists and hunters providing more and better habitats specifically to encourage waterfowl has not yet commenced. Before it does, a sound working knowledge of the numbers and fluctuations of our South African waterfowl species, all of which occur in the Transvaal or are likely to be recorded there, is highly desirable. This should preferably be correlated with a knowledge of our most suitable habitats at various seasons.

The organization of the African Wildfowl Enquiry, together with the establishment of the Rondevlei and Barberspan ringing stations,were important mile-stones in the conservation of waterfowl in South Africa. The African Wildfowl Enquiry consists of an independent group of amateur volunteers, who regularly census waterfowl on certain accessible waters. My initiation to waterfowl censussing took place in the early days of the A.W.E., as it is familiarly known, when I served as a junior to one of the ablest of the Witwatersrand pioneers, Royce Reed. The method used must remain one of the three basic methods of Transvaal waterfowl censussing, although it has certain inherent limitations.

This method is simply the careful censussing of comparatively small sheets of water by means of binoculars from one or several vantage points. It is the solid foundation on which the excellent work of the A.W.E. has been laid. Certain limitations are unavoidable, and the most important is that it is size-limited.

There is a definite limit to the size of waters which one or a pair of observers can do satisfactorily in this way. Even should it be possible to move to several vantage points with a motor vehicle, it is seldom possible to cover a really large sheet of water adequately by this means. A telescope, preferably mounted on a sturdy tripod, is an undoubted asset. I have found that when I can identify a distant bird with 10x binoculars as being a duck, with a 40x telescope under reasonable light conditions I can usually tell the species. However, sleeping duck in the distance are sometimes impossible to identify with certainty.

Should a pair of observers be sharing a census, they can check each other's tallies of the various species and classes of waterfowl. For this subdivision I have found an ordinary hand-tally, such as is used for counting sheep, invaluable. My record individual total of 5,056 Spurwing Geese (*Plectropterus gambensis*) was made with this inexpensive instrument, which is clicked per bird while counting through binoculars or a telescope. I would have great reservations in attempting to carry high counts like this in my head. Another limitation of this census method is that waterfowl hidden in dense marginal vegetation, such as rushes, are not seen and counted. This is a serious problem on a windy day, when the bulk of the waterfowl may be sheltering in such cover, but less of a problem with the second and third methods.

A more serious problem is that, while the basic principle underlying the method is sound, it is not always ideal for South African conditions. The basic principle is that by regularly censussing a relatively few selected waters, a representative sample of our waterfowl can be obtained. This may then be correlated with the results of occasional censusses of other waters not counted regularly. Fluctuations are best compared with a selected "master year". Due to the considerable movement of Transvaal waterfowl to the shallow seasonally-flooded depressions known as pans and vleis, when ecological conditions are favourable, and their total withdrawal when these pans dry up during the dry season, we have a great deal to learn of the degree of accuracy of our sampling. These numerous temporary waters are impractical if not impossible to count by the first method, but the third method is apparently well-suited to them.

The second census method is one which developed from necessity in 1963, when I commenced a study of reputed serious crop damage by the Spurwing Goose and Egyptian Goose (*Alopochen aegyptiacus*) in the Orange Free State on behalf of the Department of Agricultural Technical Services. Enormous flocks of both species were gathering on the recently-constructed irrigation dams to rest during the day, before and after the annual moult. The concentrations arising from this winter moult migration were dispersed in groups at various points along the bare shores, and it was clearly impossible to census a dam say fifteen miles long by the first method.

Fortunately I discovered very early that, while the geese were wary of motor-vehicles or men on foot, they would tolerate a motor-boat which they apparently did not associate with danger. Too close an approach, however, still put them to flight, defeating the object of the census. Luckily the geese indicated clearly when they were uneasy at being approached too closely, by repeated honking and restless waving of their heads and necks. An immediate outward directional change was usually adequate to forestall flying. On the comparatively rare occasions on which a restless segment took flight, they could be added or subtracted according to the direction in which they flew. These two species and other waterfowl normally avoid the centres of the dams, although they are fond of shallows and islands. Consequently, by a slow cruise around the perimeters of the dams, it was easy for two observers with binoculars and hand-tallies to count one goose species each and dictate numbers of the other comparatively few waterfowl species to a third person with a notebook and pencil. If sufficient care is used, waterfowl can usually be slowly herded from cover to where they can be counted. With a particularly dense concentration of ducks and geese, it was sometimes necessary to cut the engine and drift while the counters completed their slow binocular sweeps with clicks corresponding to each specimen seen. This method has proved entirely satisfactory for large dams like Allemanskraal, Erfenis and Vaal Dams except in stormy weather, and has since also been utilized successfully by the Cape Department of Nature Conservation at Voëlvlei Dam and by the Natal Bird Club on Midmar Dam.

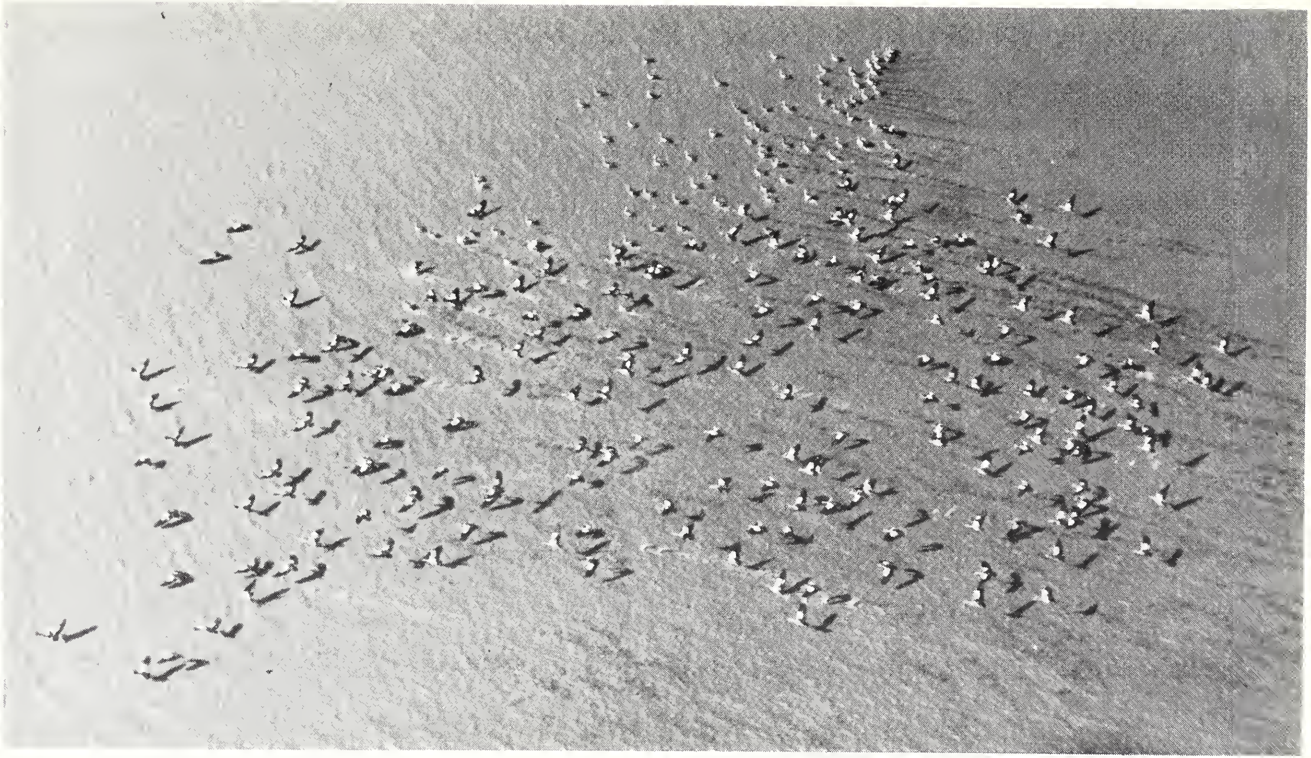
Although widely used in North America for this purpose, and occasionally utilized in Europe for off-shore waterfowl concentrations, the third census method of aerial survey has apparently only been utilized once for waterfowl in South Africa. The object was to ascertain whether in fact the wild geese concentrations on the large Free State dams were at that time remaining out on the farms, as currently claimed. Accurate figures were available for the large dam margins, where the concentrations were formerly claimed to be. In view of the minimal time required to census both the large dams and their surroundings rapidly, an aeroplane was the only suitable means.

An aerial survey was carried out on June 10, 1965, for the Department of Agricultural Technical Services. Since a co-observer was required with a thorough knowledge of waterfowl and their flight patterns, the Transvaal Director of Nature Conservation kindly permitted Mr. D. M. Skead to accompany me on the flight. A high-winged Cessna 172 monoplane was hired for economy and maximum visibility. The pilot, Mr. G. Volckerz, was also an expert navigator. A zig-zag course was flown to bodies of water plotted on 1 : 250,000 topo-cadastral sheets on which the standard South African quarter-degree biological grid had been marked out.

In a total of 10 hours, including refuelling at Welkom, the waterfowl on 38 smaller sheets of water were counted in addition to those on Vaal, Erfenis and Allemanskraal Dams and their surrounding districts. Numerous sheets of water without waterfowl were ignored, although negative counts of regularly observed waters should always be noted. The success was considerably greater than had been expected, even with previous experience of aerial quelea-surveying in the Kruger National Park. Not only was visibility excellent, but waterfowl even on tiny pans were not panicked by the aircraft. Where necessary, several rapid passes were made to identify all the waterfowl.

The species differences in ducks and geese were readily observed, for example, the coppery South African Shelduck (*Tadorna cana*) were even more easily distinguished from the fawn Egyptian Goose than was the case on boat surveys. Similarly, when duck took to flight, distinctive flight-patterns like that of the Cape Wigeon (*Anas capensis*) could not be missed. The advantage of comparative speed, to avoid possible errors during necessarily round-about ground surveys at roughly equivalent costs, together with the man-hours saved, more than compensated for the only slight disadvantage: large flocks of geese on the big dams tended to take to flight at the approach of the aeroplane, though smaller groups did not. Several excellent photographs taken by Mr. Volckerz enabled large flocks to be accurately counted.

In conclusion, these three complementary methods are well suited to censussing waterfowl in the Transvaal. For small dams and vleis which



Aerial photo showing 259 Egyptian Geese on the Allemanskraal Dam in the Orange Free State. (Photo G. Volckerz) can be regularly counted, e.g. on nature reserves, the stationary method from one or more vantage points is the most practical. For large sheets of water, a perimeter boat-survey is the most accurate. For waterfowl spread out on flooded and other inaccessible areas, an aerial survey is both practical and accurate. By utilizing a combination of these techniques, it should be possible to build up the basis of knowledge essential for sound conservation of our waterfowl. In conjunction with ringing to establish movements and longevity, breeding studies to establish relative success, studies of feeding habits and requirements to plan more suitable sanctuaries, and encouragement of hunters who are also conservationists, it should be possible for waterfowl conservation in the Transvaal to reach the heights it has in other parts of the world.

MEAT PRODUCTION OF SOUTH AFRICAN GAME ANIMALS

3. THE SPRINGBOK

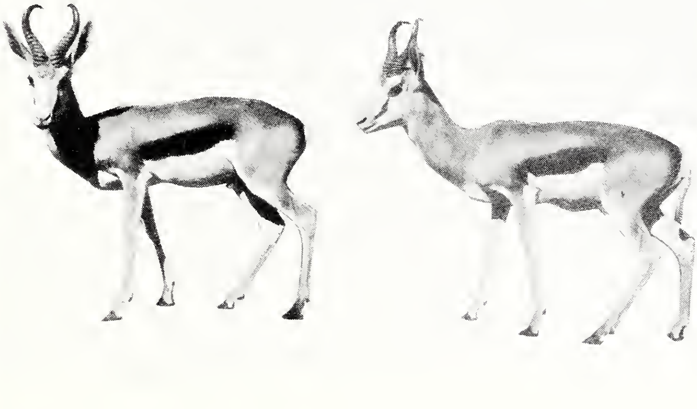
(*Antidorcas marsupialis* Zimmermann)

J. H. M. VAN ZYL

The present study is based on data obtained from twelve springbok (5 males and 7 females) hunted in the S.A. Lombard Nature Reserve during the months November to January. The animals were from 22 to 72 months old and were all in good condition. All females except No. 6 were in lamb (Addendum 1).

The methods used were similar to those of Ledger (1963) and based on experience gained in previous studies on the meat production of the eland (5) and the buffalo (6) (Fig. 1).

Data obtained for springbok in this nature reserve indicate that maximum body weight is attained at about the age of 18 months. The female becomes sexually mature at the early age of seven months (2). Hence the specimens in this study were mature for all practical purposes.



Springbok rams. The tail of one is not visible. (Official photo)

The Springbok is a virile antelope that breeds throughout the year. This emerges from the fact that during the period July, 1966, to April, 1968, the number of springbok in the reserve increased from 247 to 698. During the period April, 1967, to March, 1968, four ewes were shot every other month and 19 of the 24 were found to be pregnant. It may be claimed, therefore, that this game animal may well become a significant source of proteins in South Africa.

The body weights of the animals used in this study are considered to be a representative sample, since the data compare well with earlier records in this reserve and also with the weights reported by Roberts (1951).

The animals were hunted by shooting them in the neck or thoracic region. In most cases the loss of blood was considerable, and hence the maximum weight of blood recorded in this study is not necessarily the true weight of this tissue.

The S.A. Lombard Nature Reserve is situated in a region where the veld type is classified as a Dry Cymbopogon - Themeda Veld (Acocks, 1953). The rainfall varies from 10 to nearly 30 inches per annum with an average of 15 inches.

In this study the subcutaneous and intramuscular fat was not significant and was, therefore, included in the weight of meat.

The weight of the embryo has not been taken into account, since the different stages of development result in weight differences that may have a significant influence on the percentage yield of the various components based on weight.

Terminology

Carcase: Is the dressed body, excluding all offal (Fig. 1). The offal components are described in Addendum 1.

Carcase yield: Is the weight of the carcase as a percentage of the weight on hoof.

Alimentary Tract: Is the oesophagus and all parts of the stomach as well as the intestines beyond the stomach, inclusive of the adherent fatty tissue.

Intestines: Are the alimentary tract beyond the stomach and consist of the small and the large intestine.

Alimentary fat: Is the tissue in which the intestines and the stomach are embedded.

Cod: Is the fat from the kidneys and reproductive organs.

Discussion:

The animal's body may be divided into the edible and the non-edible components. The non-edible part accounted for about 40 per cent or more

Addendum 1 Weights and measurements of the offal of the springbok in the S.A. Lombard Nature Reserve (Pounds and ounces, e.g. 4.13 means 4 lbs. 13 ozs.).

Number of animal	1	2	3	4	5	6	7	8	9	10	11	12	Range	Mean
Sex	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀	♀		
Age (months)	72	36	25	32	42	36	54	22	32	24	60	32		
Time hunted	8 a.m.	10 a.m.	10 a.m.	11 a.m.	5 p.m.	5 p.m.	8 a.m.	8 a.m.	11 p.m.	1 p.m.	10 a.m.	3 p.m.		
1. Weight of blood*	1.12	2.7	1.9	2.15	1.0	3.0	2.13	2.12	1.10	2.9	1.8	1.9	1.0-3.0	2.2
2. External Offal: -														
a) Head (unskinned with tongue)	5.0	4.14	4.14	5.3	4.13	3.3½	2.12	3.3	3.1	3.0	2.12	2.15	2.12-5.3	3.13
b) Skin	4.4	3.15	4.6	4.2	4.10	2.10½	2.13	3.2	2.8	2.7	2.9	2.15	2.11-4.10	3.6
c) Tail	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1½	0.1	0.1	0.1	0.1	0.1-0.1½	0.1
d) Unskinned feet	1.14	1.12	1.11	1.13	1.15	1.10	1.2½	1.9	1.4	1.5	1.2	1.6½	1.2-1.14	1.8
3. Internal Offal: -														
a) Heart	0.11	0.8	0.9	0.9	0.9½	0.8	0.8	0.9	0.9½	0.7	0.8	0.7	0.7-0.11	0.8½
b) Lungs (with trachea)	1.8	1.2	1.4	1.7	1.5	1.0	1.1½	1.1	0.15	1.5	1.5	1.3	0.15-1.8	1.3½
c) Liver (with gall-bladder)	1.6	1.2	1.2	1.6	1.5	1.5	1.3½	1.5	1.10	1.6	1.5	1.5	1.2-1.10	1.4½
d) Gall-bladder (full)	Less than one ounce except where indicated.											0.2	<0.1-0.2	-
e) Oesophagus (empty)	0.1½	0.1½	0.2	0.1½	0.1½	0.1½	0.1½	0.1½	0.1½	0.1½	0.1½	0.1½	0.1½-0.2	0.1½
f) Udder	-	-	-	-	-	0.8	0.1	0.2½	0.4	0.3	0.2	0.9	0.2-0.9	0.4
g) Stomach i) Full, with fat	8.10	6.10	7.9	9.10	10.13	11.2	6.7	6.14	6.2	6.0	4.12	6.5	4.12-11.2	7.9
ii) Fat	0.1	0.2	0.1	0.2	0.3	0.3	0.1	0.10	0.6	0.4	0.3	0.4	0.1-0.10	0.3¼
iii) Empty	2.9	2.0	2.1	2.5	2.11	2.6	2.0	-	2.1	2.0	1.11	2.1	1.11-2.11	2.4
iv) Contents	6.0	4.8	5.7	7.3	7.15	8.12	4.7	-	3.9	3.10	2.14	4.0	2.14-8.12	5.4
h) Intestines i) Full with fat	6.9	5.4	5.1	4.7	3.11	5.4	5.5	5.5	3.14	4.7	3.7	3.14	3.7-6.9	4.4¾
ii) Fat	0.5	0.6	0.5	0.4½	0.5	0.4	0.6	1.3	0.8	0.4	0.5	0.6½	0.4-1.3	0.6½
iii) Small intestine (full)	1.8	3.4	2.10	2.0	1.11	3.2	2.11	2.8	1.10	1.11	1.3	1.14	1.3-3.4	2.2¼
iv) Small intestine (empty)	1.1	1.6	1.7	0.10	0.13	1.3	1.3	1.3	0.11	0.13	0.9	0.13	0.9-1.7	0.15½
v) Large intestine (full)	2.6	1.10	2.2	2.2½	1.9½	1.14	1.15	1.10	1.11	2.3	1.12	1.8½	1.9-2.6	1.14
vi) Large intestine (empty)	1.5	0.12	0.13	0.9	0.12	0.12	0.14	0.13	0.13	0.11	0.9	0.11	0.9-1.5	0.12½
i) Length: - small intestine (inches	628	543	593	539	623	636	595	643	596	549	497	591	497-643	586
ii) Large intestine (inches)	208	179	196	212	183	216	144	192	217	192	213	188	144-217	195
j) Kidneys: - Left, with fat	0.1¼	0.2½	0.2	0.3	0.2½	0.2¼	0.2	0.6½	0.7	0.5	0.3½	0.4	0.1¼-0.7	0.3¼
ii) Fat	0.0¼	0.1	0.0¼	0.1	0.1	0.0½	0.0½	0.4½	0.5	0.3½	0.2	0.2¼	0.0¼-0.4½	0.1½
iii) Right, with fat	0.1¼	0.2½	0.2	0.3	0.2¼	0.2½	0.2	0.5½	0.7½	0.6	0.4	0.4¼	0.1¼-0.7½	0.3¼
iv) Fat	0.0¼	0.0¾	0.0¼	0.1	0.1	0.0½	0.0½	0.3¾	0.4½	0.4	0.2¼	0.3	0.0¼-0.4	0.1½
k) Spleen	0.1½	0.1½	0.2½	0.1½	0.2	0.1½	0.4½	0.1½	0.1	0.1	0.1	0.1	0.1-0.4½	0.1½
l) Reproductive organs (bladder incl.)	0.8	0.10	0.11¾	0.6	0.8½	0.2¾	9.0‡	8.0‡	9.4‡	8.14‡	11.6‡	11.1‡	- -	-
m) Diaphragm	0.8	0.5	0.6	0.7	0.7	0.4	0.5	0.7	0.9	0.7	0.7	0.5	0.4-0.9	0.6¼
4. Total weight of internal & external offal + kidneys + reproductive organs.	33.2	29.2	29.12	33.0	31.10	31.2	25.6†	27.9†	23.2†	24.10†	24.11†	23.12†	23.2-33.2	28.1¼

* = No correction for blood lost by shooting.

‡ In lamb † = Weight of embryo not included. It is assumed that the weight of the reproductive organs of the female (not in lamb) is three ounces.

Addendum 2 Carcase weight of the springbok in the S.A. Lombard Nature Reserve (Pounds and ounces, e.g. 4.13 means 4 lbs. 13 ozs.).

Number of animal	1	2	3	4	5	6	7	8	9	10	11	12	Range	Mean
ex	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀	♀		
Age (months)	72	36	25	32	42	36	54	22	32	24	60	32	22-72	39
Weight on hoof	79	74	72	85	85	65	55	74	71	73	67	69	55-85	72.8
Dressed carcase	48.9	43.13	40.12	49.1	53.5	34.0	28.12	40.10	36.15	36.6	32.13	33.8	28.12-55.4	39.12
Components of carcase: -														
Forequarter (both sides)	23.5	22.0	19.15	24.7	27.1	15.7	12.0	17.12	14.8	15.2	13.10	13.4	12-27	17.12
(i) Forelegs	8.6	7.9	6.12	8.0	9.0	6.3	4.12	6.14	5.14	5.10	5.6	5.10	4.12-9	6.12
(ii) Neck & thorax	14.15	14.6	13.3	16.7	18.1	9.3	7.4	10.13	8.10	9.8	8.4	7.10	7.4-18	11.8
) Hindquarter (both sides)	25.4	21.13	20.13	24.8	26.4	18.9	16.7	22.14	22.4	21.4	19.3	20.4	16.8-26.4	21.8
(i) Loin & flank	7.9	6.11	5.15	7.6	8.10	5.5	4.11	7.8	7.12	6.12	6.6	5.15	4.12-8.8	6.12
(ii) Hindlegs	17.11	15.2	14.14	17.2	17.10	13.4	11.12	15.6	14.8	14.8	12.13	14.5	11.12-17.12	15
Carcase yield: -														
) Lean (excluding bone & tendons)	38.15	34.0	32.10	39.6	41.8	26.3	21.15	32.8	29.9	29.14	25.4	26.6	22-41.8	31.8
) Butchersbone & tendons	9.0	8.9	7.10	9.10	10.15	7.5	6.7	7.6	6.14	6.6	7.6	5.14	6.4-11	8.8
) True bone	8.6	7.8	6.14	8.12	9.15	6.10	6.1	6.11	6.6	6.0	6.12	5.10	5.8-10	7
Loss of moisture, etc. during the slaughtering process.	0.10	1.4	0.8	0.1	0.14	0.8	0.6	0.12	0.8	0.2	0.3	1.4	0.1-1.4	0.8

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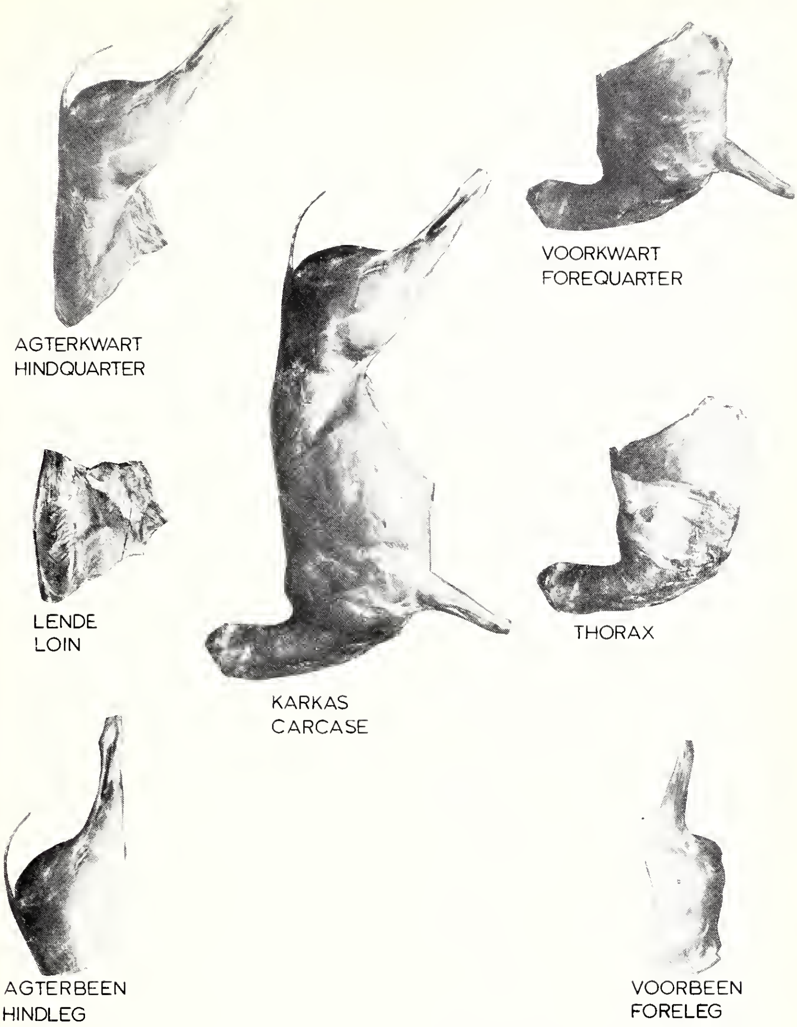

Fig. 1 *The component parts of the carcase of the Springbok.*
(Official photo)

of the total body weight. The various components of the offal are listed in Addendum 1. The rest of the body is represented by the yield of the various parts of the carcase as recorded in Addendum 2.

The yields of the various body components and the carcase of each individual animal are given in Table 1 and 2.

Table 1 The average percentage yield of various components of the carcases of twelve springbok on the S.A. Lombard Nature Reserve in comparison with the yield of the Buffalo (6) and the Eland (5).

Percentage of:	Buffalo	Eland	Springbok *	Range for Springbok
1. Offal on total body wght.	41.0	39.7	38.7	32.4 - 47.7
2. Alimentary tract + contents on total body wght.	15.9	15.5	16.4	12.3 - 25.4
3. Digestive tract contents on total tract wght.	60.7	64.5	63.3	49.2 - 72.3
4. Digestive tract contents on total body wght.	9.6	9.9	10.4	7.1 - 16.6
5. Alimentary fat on total tract wght.	17.5	-	5.1	3.0 - 9.8
6. Alimentary tract (excluding fat) on carcase wght.	13.1	-	28.5	23.7 - 40.0
7. Blood on carcase wght.	6.2	5.8	5.3	1.9 - 9.6
8. Skin on total body wght.	9.0	7.5	4.7	3.4 - 6.4
9. Carcase yield	55.2	59.0	54.9	48.6 - 62.6
10. Fat and lean on carcase wght.	76.2	82.0	79.0	76.5 - 82.2
11. Fat and lean on total body wght.	41.2	48.8	43.2	37.7 - 49.4
12. Butcher's bone on carcase wght.	-	-	19.8	17.9 - 22.9
13. True bone on carcase wght.	16.7	18.0	18.2	16.6 - 20.9
14. Loss of wght. in slaughtering process.	4.2	3.7	0.05	- -

* = Based on average figures of Add. 2.

Table 2 The components of the carcase of twelve springbok in the S.A. Lombard Nature Reserve, expressed as a percentage.

Number of animal	1	2	3	4	5	6	7	8	9	10	11	12
Sex	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀	♀
Age (months)	72	36	25	32	42	36	54	22	32	24	60	32
Percentage of:												
1. Offal on total body wght.	41.8	39.2	41.7	38.8	37.6	47.7	45.5	37.9	32.4	34.3	37.3	34.8
2. Alimentary tract + contents on total body wght.	19.3	16.2	17.7	16.8	17.4	25.4	21.5	17.0	14.4	14.4	12.3	14.9
3. Digestive tract's contents on total tract wght.	49.2	60.4	56.1	72.3	66.1	71.2	58.3	-	53.7	57.1	57.6	58.6
4. Digestive tract's contents on total body wght.	9.5	9.8	11.1	12.1	11.5	16.6	12.7	10.8	7.7	8.2	7.1	8.7
5. Alimentary fat on total tract wght.	3.3	4.2	4.7	4.9	3.4	3.0	4.2	14.0	9.8	4.8	6.1	7.3
6. Alimentary tract (without fat) on carcase wght.	30.9	26.3	30.7	28.0	27.4	47.1	40.0	25.8	25.0	27.6	23.7	29.1
7. Blood on carcase wght.	3.6	5.7	3.7	6.1	1.9	9.0	9.6	6.7	4.7	6.9	4.6	4.5
8. Skin on total body wght.	5.4	5.4	6.4	5.0	5.6	4.2	5.0	4.4	3.5	3.4	3.7	4.3
9. Carcase yield	61.4	59.1	56.6	57.6	62.6	52.3	52.3	55.0	52.1	49.7	48.9	48.6
10. Fat and lean on carcase wght.	80.5	77.7	80.3	80.6	77.9	77.2	76.5	79.8	79.7	82.2	76.5	79.1
11. Meat on total wght.	49.4	46.0	45.5	46.5	48.8	40.4	40.0	43.9	41.5	41.1	37.7	38.0
12. Butcher's bone on carcase wght.	18.6	19.4	19.0	19.9	20.7	21.3	22.6	18.4	18.9	17.9	22.9	17.9
13. True bone on carcase wght.	17.5	17.1	17.2	17.9	18.8	19.9	20.9	16.6	17.6	16.6	20.6	17.2
14. Hindquarter on carcase wght.	52.0	50.0	51.2	50.0	49.3	54.4	58.4	56.4	61.0	58.2	58.8	60.5
15. Loss of weight in slaughtering process.	0.9	1.7	0.7	-	1.2	0.8	0.9	1.0	0.6	-	0.4	2.0

The loss in weight during the slaughtering process is not significant in the case of the springbok (Table 2). It was found that it is possible to dissect, weigh and measure one animal in 45 minutes time with the aid of four trained assistants.

The body components in the sexes differ, and the greatest individual variation in weight is found in female animals, except for the digestive tract. The latter varies about 23 per cent amongst the five male springbok. (Table 2).

From Table 1 it is clear that the percentage offal in the case of the springbok does not vary significantly from the figures obtained in earlier studies on the eland (5) and buffalo (6). It is also fairly constant in this species and varies from 39 - 41 per cent in both sexes. Most components of external and internal offal of the male springbok are heavier than that of the female, e.g. head, trotters, skin, heart, lungs, liver and stomach (empty) (Table 2). The intestines (empty and without fat) do not follow this pattern and are fairly constant in weight in both sexes except for a few exceptions also amongst both sexes.

The alimentary tract forms a bigger proportion of the total body weight in the springbok than either in the eland (5) or the buffalo (6). (Table 1). This is due to the proportionally higher contents of the digistive tract in the springbok. The full fat-free alimentary tract amounted to 28.5 per cent (average) of the total carcase weight, which is more than twice the figure obtained for the buffalo (6). This high yield of the tract's contents for the springbok may account for the animal's ability to thrive frequently on the inferior vegetation characteristic of its natural abode in the arid central western parts of the Republic.

From the available data it seems that the contents of the alimentary tract are at the lowest point just after noon. They are appreciably higher in animals shot in the forenoon and late afternoon. (Table 2, Nos. 1-8).

The fat of the alimentary tract is low, viz. 5.1 per cent against 17.5 per cent in the case of the eland (5). (Table 1).

The skin accounted for a less significant proportion of the offal than in both the eland (5) and buffalo (6). It is light in weight but strong and with its beautiful colour pattern a well-known article frequently found in South African homes.

The length of the intestines is only 65 ft. (Add. 1), against the 120 ft. of the buffalo (6). The ratio of the large intestine to the small intestine is exactly the same as in the buffalo, where it is 1 : 3.

The average carcase yield is 55 per cent for the springbok and even exceeds 62 per cent in some males (Table 2); this is the yield of a very fat steer (Ledger, 1963), in which the fat alone is 40 per cent. The fat yield of the springbok is very low (less than one per cent), and this accounts for a very high protein yield in this game species.

The edible part of the carcase (fat and lean) calculated on carcase weight is 79.0 per cent and varies from 76.5 per cent (76.2% - buffalo) (6) to 82.2 per cent (82.0% - eland) (5) (Table 1). The total lean meat calculated on total weight is 43.2 per cent and varies from 37.7 to 49.4 per cent. According to Ledger (1963) this is constant for all game and varies between 41 per cent and 46 per cent according to the species. In the case of the eland (5) a figure of 48.8 per cent was obtained, whereas the 12 per cent variation indicated by the present results for the springbok does not indicate a constant figure for game. All figures obtained hitherto for meat to total body weight are higher than that of the steer (*Bos indicus*), which is only 32 per cent (Ledger, 1963).

The "true bone" of the dressed carcase amounts to 18.2 per cent and is similar to the figures obtained for the eland (5) and buffalo (6) (Table 1).

The fore- and hindquarter of the individual male springbok has the same weight (Add. 2), whereas Ledger (1963) found that the forequarter in male game animals was always heavier. In the case of the female springbok the hindquarter is heavier and in accordance with what Ledger found. It accounted for 54.4 per cent to 61.0 per cent of the carcase yield, whereas the hindquarter of the steer seldom yields more than 54 per cent (Ledger, 1963).

Acknowledgements

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THE TRANSPORTATION OF LIVE BLESBOK (DAMALISCUS DORCAS PHILLIPSI)

G. P. VISAGIE

The development of agriculture often has a detrimental effect on natural game populations, but there are farmers who realize that game conservation can be integrated with ordinary farming. For this purpose odd pieces of land or land not suitable for stock (e.g. land infected with poisonous plants) are used. There are also farmers who set aside large tracts of land for the special purpose of conserving game. In the Highveld, blesbok are considered to be the best type. They are easily caught in a crush, are not difficult to handle and can be confined by a good cattle fence. They adapt themselves to virtually any type of veld.

Blesbok are liberated on a farm. (Official photo)

In the Transvaal there are two centres from which large numbers of blesbok are distributed at more or less regular intervals, namely the Percy Fyfe Nature Reserve and the Van Riebeeck Nature Reserve. Here the animals are caught in a circular crush (Riney and Kettlitz, 1964).

Animals may be hurt in the crush, but the fact that two farmers who bought animals from the same batch had mortality differences of 100% focussed attention on the method of transportation. This is certainly not the only factor responsible for mortality, but it is the only one that can be controlled.

In order to compare the success of the various methods of transporting blesbok, questionnaires were sent to all buyers during the period 1962 to 1965. Eighty per cent of the questionnaires were returned, and the results are given in the table.

Percentage mortality of blesbok transported by various methods from the Van Riebeeck Nature Reserve and the Percy Fyfe Nature Reserve. (1962-1965)

Mode of Transport	Number of Consignments	Number of animals transported	Percentage mortality
In bag with sedative	10	89	40.6
In bag without sedative	22	129	28.0
In closed vehicle with sedative	17	182	4.0
In closed vehicle without sedative	24	217	8.2
In crate with sedative	1	12	8.3
In crate without sedative	6	33	12.5

The transportation of blesbok in grain-bags is unnatural and undesirable. In this case each animal is placed in a good grain-bag in the normal lying position with its head free. The loose part of the bag is rolled up and fastened with a thin wire. If the whole batch has been ' bagged", they are placed head-to-tail on a thick layer of grass or damp soil on the back of the vehicle. At least one supervisor is required for every five to six animals. Non-sedated "bagged" animals have a very low chance of survival; even when sedated, the survival rate is as low as 60%. Hence this mode of transportation cannot be recommended.

Although the figures for animals in single crates are quoted in the table, the total number transported (45) is too small to give comparable averages. This method, although successful, is unpractical since the cost of the crates is high and not more than two or three can be loaded onto a three-quarter ton vehicle.

The best method is to transport blesbok in an enclosed vehicle. Five or six animals can easily be loaded onto a three-quarter ton vehicle. The hood on the back of the van is simple and inexpensive to construct, and mortality is reduced to a minimum.

Construct a framework over the body of an ordinary lorry and cover it with stuffed bags to prevent the animals from injuring themselves. The interior must be as dark as possible, but well ventilated and free from dust. A door at the back, well covered, and functioning properly ensures that animals can be loaded rapidly. A damp layer of sand or earth must and the remainder covered with pieces of close-fitting garden hose. Each cover the floor to prevent the animals from slipping on the metal. To prevent butt-wounds, the sharp points of developed horns can be cut off animal should be treated with an antibiotic before the journey. If desired by the buyer, a proven sedative is administered.

It is seldom necessary to provide food or water during the journey, but it is essential that the destination be reached with as little delay as possible. Fast acceleration, sharp turns and sudden stops can, of course, cause injuries.

The demand for blesbok is greatly in excess of the supply. Since much money and energy are expended on restocking, it is necessary to use only the best method of transportation as described here. Suppliers of blesbok should not sell them to persons who are not properly equipped to transport the animals.

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THE LICE OF MAMMALS

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The study of ectoparasites in relation to nature conservation is often seen only in terms of the pathological conditions in game caused either directly or indirectly by parasites. From an academic point of view, however, parasitology has much to offer, for most parasites are closely associated with the host and in many cases this relationship is reflected in the taxonomic affinities of the parasites themselves. The parasitologist is generally bound to his laboratory and microscope - on field trips he can hope to sample only a fraction of the animals necessary for his investigations. The nature conservator, on the other hand, is in daily contact with wild animals, but rarely has the time, facilities or equipment to study parasites in the field, and hence they must be sent to a specialist. If the study of the ectoparasites of our game is to keep pace with advances in other fields of wildlife research, there must be close co-operation between nature conservators and parasitologists. The former must collect carefully and thoroughly, while the parasitologist must be able to identify the material sent to him, determine the actual or potential importance of the parasites and make the results of his research known.

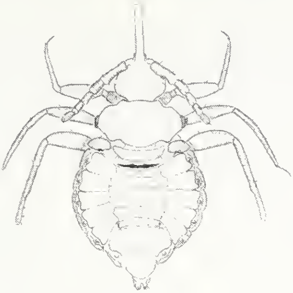
The lice are a group of ectoparasites that are of great academic interest for the reason that they spend the entire life-cycle on the same host, moving to a new host only during close bodily contact. Moreover, a louse species can usually only live on a single host or on two or more closely related hosts. This means that the lice of related hosts are themselves related, and very often the parasitologist can decide the species of host merely by examining the lice taken from it.

All lice are specialized, wingless, parasitic insects of the order Phthiraptera, that can be further subdivided into the suborders Anoplura, Mallophaga and Rhynchophthirina. The Anoplura are commonly called "sucking lice" and are to be found on mammals only; the Mallophaga are often called "biting lice" and occur on both mammals and birds (the majority of species being found on birds); while the Rhynchophthirina are represented by a single genus containing two species parasitic on elephants and warthogs. Let us now consider a few interesting examples of the parasitism of mammals by lice.

The elephant louse *Haematomyzus elephantis* Piaget has fascinated parasitologists ever since its description in 1869. This louse has a long proboscis or rostrum, at the end of which is borne a pair of recognizable mandibles; early workers soon placed *Haemotomyzus* as intermediate between the Mallophaga and Anoplura, for the former have mandibles but no rostrum while the latter have modified sucking mouthparts but no recognizable mandibles. At first sight the elephant louse would appear to be an aberrant Mallophagan that developed its mandibles on a rostrum in order to penetrate the heavy hide of the host; however, other scientists believe that *Haematomyzus* is related to certain members of the *Anoplura.* The answer to the ancestry of *Haematomyzus* may perhaps lie preserved with the ice-age hairy mammoths, as proposed by earlier workers on the subject.

Haematomyzus is unlike any other members of the Phthiraptera, and reflects in its isolation the position of the elephants among other mammals. Lice from the Indian and African elephants are not separable, and this poses a problem, for fossil evidence indicates that the ancestors of *Elephas* and *Loxodonta* diverged long before the Pleistocene period, and that the two groups were later separated by an impassable barrier between Asia and Africa. We would expect such a long isolation to have given rise to separate species of *Haematomyzus* on the two elephant groups. The intervention of man has brought the two elephants together in captivity, but this cannot explain the occurrence of the same species of louse on wild hosts in Asia and Africa.

Fig. 1 *An elephant in the Kruger National Park.* Photo: S. Ulrich



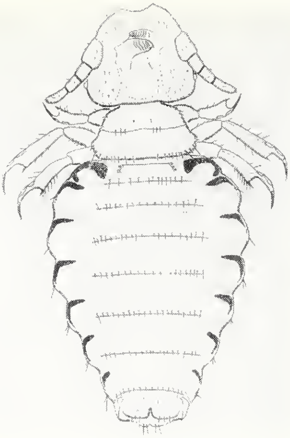


Fig. 2 Damalinia martinaglia *Bedford. Host-specific on the Red Lechwe* (Kobus leche)

Fig. 3 *The elephant louse* Haematomyzus elephantis *Piaget*

In 1963 Dr. Theresa Clay of the British Museum (Natural History) provided further food for thought when she described *Haematomyzus hopkinsi*, based on specimens taken from warthogs in Kenya and Uganda. Obviously a number of possibilities now exist which may explain the occurrence of *Haematomyzus* on such widely different hosts as elephant and warthog, one of these being that the louse may have arisen on an ancestor of warthogs whose distribution overlapped those of the two elephant genera or their ancestors. It is not likely that the true origins of *Haematomyzus* will ever be discovered, and it may be noteworthy that we in South Africa have not yet taken *Haematomyzus* from wild elephant or warthog, despite a relative abundance of both hosts; is the louse absent, or are we perhaps careless in our collecting?

Passing from elephant to rhinoceros, we find that no lice have been recorded from the latter and probably none do occur because of the almost hairless skin; but the now-extinct ancestors of modern-day rhinos were endowed with woolly coats, and there is no reason to believe that lice were absent from these creatures, especially as *Haematomyzus* has shown that a thick skin is no obstacle to the adaptability of the Phthiraptera.

The bats are generally considered to be louse-free and although several "records" have been published, all have subsequently proved erroneous. Bats are abundantly parasitized by mites and specialized flies of the families Nycteribiidae and Streblidae; this may explain the absence of lice, but it is not altogether convincing, and several scientists believe that lice will be found at least on certain species of bats. It is perhaps significant in this regard that lice have been recorded from Insectivores, including the "Flying Lemurs" that are believed to be fairly close to the line which gave rise to the bats.

The genus *Damalinia* (Mallophaga) is widely distributed over hosts of the Artio- and Perissodactyla and includes many species of economic importance on domestic animals. Most of our antelopes each have a separate species of *Damalinia,* but some have not yet been examined and several new lice are undoubtedly awaiting discovery.

Felicola (Mallophaga) is a genus confined to the families Viverridae, Hyaenidae and Felidae of the Carnivora. The lice of the Aardwolf (*Proteles cristatus*) were described in 1932, but despite fairly thorough searching no lice were found on hyaenas for a long time, and it was postulated that they were probably louse-free. In 1960, however, lice were discovered and described from *Hyaena brunnea* collected in Botswana; they proved to be remarkably close to *Felicola* from the Aardwolf, emphasising the close phylogeny of the latter with the true hyaenas. This case is instructive, for it has a bearing on the next point: lice are known from several species of *Felis,* but strangely enough none have ever been taken from our big cats, lion and leopard, this despite the large number of lion skins on walls and floors throughout the world, and numerous leopard skins on lovely ladies everywhere. It is most unlikely that the King of the

Fig. 4 *Red Lechwe* (Kobus leche) *run away from the camera.* Photo: F. Zumpt

Beasts is without lice, and it is almost certain that these will be found when a diligent search is carried out.

We have considered only a few of the many interesting problems associated with the host-relationships of the lice of mammals. Much work remains to be done, and to return to the theme of this feature, the rate of progress will depend on the degree of collaboration between scientists in the field working with mammals and scientists in the laboratory studying mammal parasites.

The photo on the outside of this page is of a *Streptocarpus* plant. Official photo.

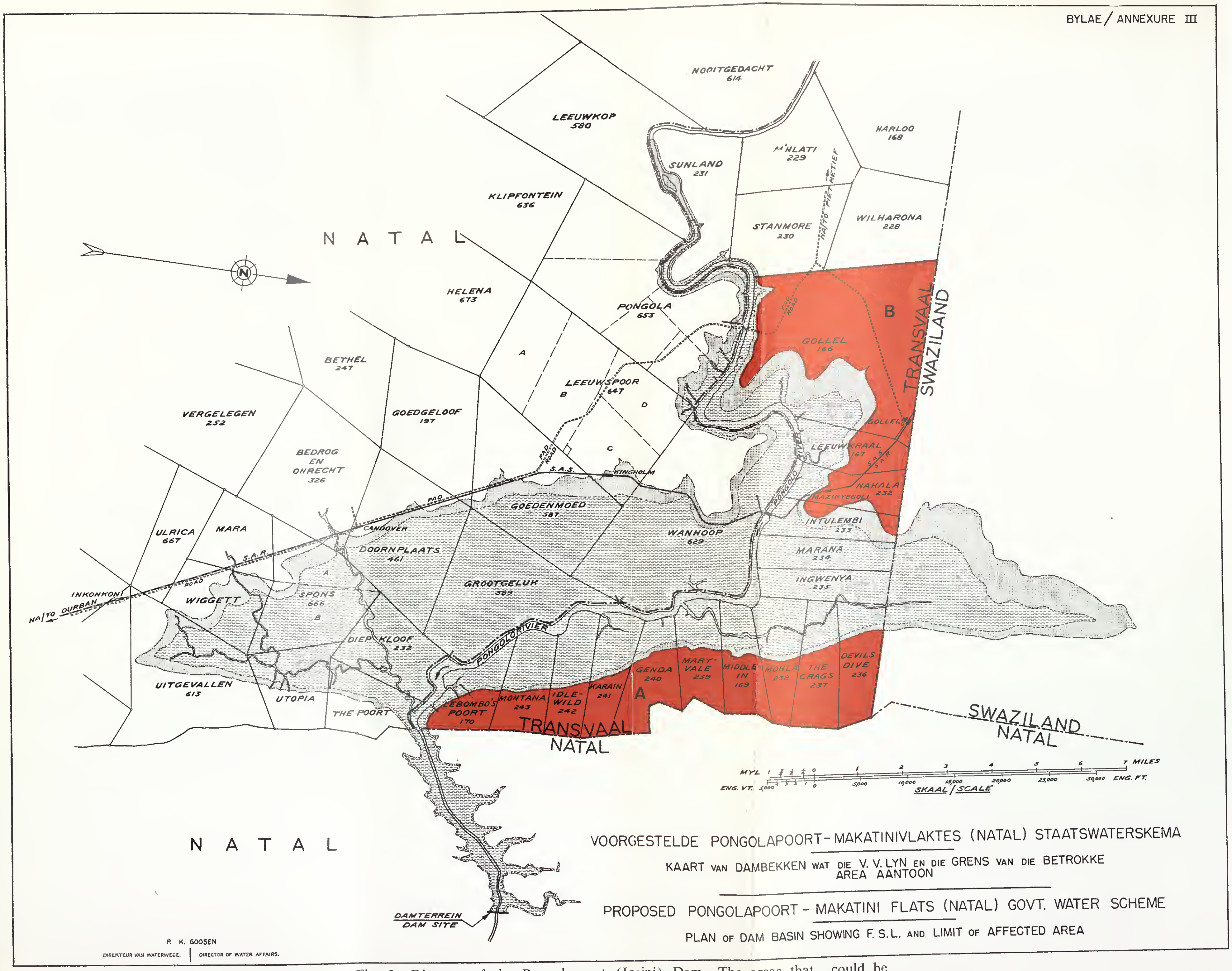


Fig. 2. Diagram of the Pongolapoort (Josini) Dam. The areas that could be proclaimed nature reserves are shown in red. (This diagram of the Pongolapoort Dam is reproduced in terms of the Government Printer's authority No. 3667 of the 17th March, 1966.)